

HORTICULTURAL ABSTRACTS.

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Abstracts. Initialled abstracts in this number are by J. L. Edgar, H. L. Pearse and H. Wormald.

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Horticultural Abstracts

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HORTICULTURE—MISCELLANEOUS.

617. VIKTOROVSKY, G. P. 91.041 : 581.9
Methods of collecting on botanical exploring expeditions [Russian].
Plant Industry in U.S.S.R., 1934, published by Inst. Plant Industry, Lenin-
 grad, 1935, pp. 151-6.

The methods employed by the various Soviet collecting expeditions in packing and transporting living plant material for future propagation are described. In examining an area for indigenous types of fruit trees a base camp is established in which are planted a variety of rootstocks sufficient for estimated needs. Scions are sent in by the collectors and worked on to the stocks by a horticulturist resident at the camp. An artist also remains permanently at the camp to make drawings. In the case of fruit these are shaded pencil drawings, but in conjunction a graduated colour chart is used on which the fruit colours and the local variations thereof are noted. The shaded portions are numbered to correspond with the colour they represent. The charts used have a hole in the centre of each colour in which the fruit can be placed for more accurate comparison. Wild fruits, like cultivated ones, have the biennial bearing habit so that information as to possibilities of crop should be obtained before starting. Notes are given of the equipment required, and there are instructions for packing seeds, cuttings, grafts and buds so that they will remain fresh. There is also a data schedule of 22 items to be filled in in the field for a collected specimen with a further 62 on return to the base camp. In spite of this each member expects to collect about 300 specimens a month. Instructions are given as to the features to be brought out in making photographic records and the proper manner of keeping a diary.

618. NEUBAUER, H. F. 581.13 : 634.1/8
 Untersuchungen zur Ökologie der Photosynthese einheimischer Laubgehölze
 in Wald und Garten. (**The ecology of photosynthesis of indigenous bushy
 plants in wood and garden.**)
Gartenbauwiss., 1936, 10 : 380-421, bibl. 45.

The author describes his technique for rapid determination of assimilation. The following notes are taken from his summary. Surplus assimilation varies greatly with the time of day. In dull weather or in the first fine days after a dull spell leaves do not assimilate well, and they only develop great intensity of assimilation when there have been several successive fine days. This is especially noticeable in the chief growing period. There is a fine and a bad weather type of photosynthesis. In the case of beech and hornbeam the greatest intensity of assimilation was noted during the fine weather type. The maximum intensity occurs under most favourable conditions, i.e. fine weather, in the morning. In bad weather maximum intensity occurs in the afternoon and evening. In fine weather the day's maximum may be 8 times that experienced in bad weather. Trees with strongly developed xylem show under favourable conditions the greatest assimilation intensity and the largest products of metabolism. In high summer leaves assimilate very intensively between 4 and 8 a.m., though the intensity drops between 7 and 9 a.m. CO₂ is often emitted at this time. Young leaves both assimilate and respire more intensively than old ones. Assimilation and metabolism are both more intensive in spring,

i.e. at the outset of growth, and storage of the products gradually sinks in the autumn. From the end of September till leaf fall assimilation is very slight and the day's balance of surplus assimilation less CO_2 given off is almost nil. Hazel leaves were examined with special care as regards this particular. Differences in the assimilation made by sun and shade leaves are merely quantitative. CO_2 emission in light does not appear to be caused by high temperature, since it occurs only on fine days. Its cause remains undetermined. The factors influencing photosynthesis may be divided into 2 groups. The first 4 (weather conditions, growth point reached, need for and use of raw material in metabolism, and age of leaves) are responsible for the type of the assimilation curve and the amount of the day's assimilation production. The secondary factors (climatic, etc.) determine the intensity of assimilation at particular moments within certain limits, and their effect is relative. Further, an attempt is made to establish correlations between factors, the effect of which on photosynthesis is studied from experimental ecology and assimilation intensity in the open. In about 56% of cases the assimilation curve runs parallel with that of the CO_2 factors for at least part of the way. On fine days also the condition of the stomata appears to affect photosynthesis. Temperature and the other factors appear under natural conditions to be of only secondary importance.

619. DESAI, S. V., AND FAZUL-UD-DIN. 581.13

Photo-chemical oxidation by plant materials.

Indian J. agric. Sci., 1936, 6 : 985-90, bibl. 3.

It has been observed that nitrogen can be assimilated in ammoniacal form by plants under certain conditions. The results reported in this paper indicate how such oxidation is possible by photo-chemical means. The work was done on one crop only, berseem (*Trifolium alexandrinum*).

620. TURRELL, F. M. 581.144.1

The area of the internal exposed surface of dicotyledon leaves.

Amer. J. Bot., 1936, 23 : 255-64, bibl. 35.

The author describes a method of estimating the total cell surface exposed to the intercellular spaces in the interior of a leaf. The necessary data are obtained from permanent preparations of sections taken transversely, and tangentially across the leaf. The material is fixed in formalin (3%) and chromoacetic acid (1%) which he claims causes no extension or shrinkage of the cell wall. The technique involves the direct measurement of the lengths of the palisade cells using a micrometer eyepiece, and chartometer and planimeter measurements of several camera lucida drawings per leaf. Empirical formulae are evolved for calculating the ratio R of the cell surface exposed internally to the external leaf area, per sample volume of leaf lamina, for various morphological types of leaf. Measurements made on a theoretical leaf drawn to specification showed an error of only 2% between the calculated and experimental values. The results indicate that the total cell area exposed internally may vary considerably in leaves of different species, and also in differently placed leaves on the same plant. The internal cell surface exposed per unit external leaf area is low for shade leaves, intermediate for mesomorphic leaves, and high for xeromorphic sun leaves. A tentative suggestion is made that, where a high transpiration rate is associated with a xeromorphic structure, this may be explained by the high ratio of internal cell surface exposed to the external area in such leaves. The cell area exposed in palisade mesophyll is shown to be 1.6 to 3.5 times greater than in spongy mesophyll, per unit volume, and to this fact is attributed the large internal surface exposed in xeromorphic leaves.

H.L.P.

621. HOAGLAND, D. R., AND BROYER, T. C. 581.144.2 : 581.192

General nature of the process of salt accumulation by roots with description of experimental methods.

Plant Physiol., 1936, 11 : 471-507, bibl. 43.

A technique is described for the study of salt accumulation by excised roots. It is shown that potassium salts accumulate very rapidly in the sap of excised roots, against concentration

gradients. Variables needing careful control or evaluation in such studies are (a) age of roots and proportion of actively metabolizing cells, (b) initial salt content of roots, dependent on supply of nutrient salts provided during preliminary growth period, (c) seasonal effects on development of root system, (d) available carbohydrate, (e) variability of material. Accumulation of salt is associated with active aerobic respiration of the roots. An adequate supply of oxygen is indispensable for both cation and anion accumulation. Data pertaining to effects of varying oxygen tensions on salt accumulation are discussed. Temperature coefficients of salt accumulation were found to be of a high order, but evidence of this can be obtained only under experimental conditions carefully chosen to eliminate certain complicating factors. These experiments on excised roots lead to fundamental conclusions similar to those derived from experiments on salt accumulation by storage tissues, and additional aspects of the problem of salt accumulation are presented for study. Attention is directed to the importance of the results on salt accumulation by root cells relative to other problems such as root pressure, translocation of salts and the general metabolism of root cells. Though the experiments were performed with barley roots, which are especially adapted to investigations of this nature, the results have a general application. [From authors' summary.]

622. PREVOT, P., AND STEWARD, F. C. 581.144.2 : 581.192
Salient features of the root system relative to the problem of salt absorption.
Plant Physiol., 1936, **11** : 509-34, bibl. 34.

The absorption of salts by roots is reviewed with reference to current views on the one hand and physiological anatomy on the other. The functional absorbing zone (in barley in water culture) is limited by factors which operate upon the cortical cells, but the potential absorbing surface extends from the apex to the point of junction with the secondary roots. The roots were unsubsized. There are no data for unbranched roots with a suberized exodermis. With all the plants tested (barley, broad bean, cotton) the segments near the apex attain higher concentrations of salt than those more remote. This progressive gradation is considered to be an inevitable consequence of the progressive development of cells from the root apex and may be taken as common to all plant roots of either high or low salt absorption capacity. It is also shown that the root can still accumulate salts near the apex of new growth, even when its special features do not permit it to accumulate salts throughout its whole mass. Interrelations between effects of time, nutrition, and salt accumulation are discussed, as also the probable rôle of the root cortex. The contribution of the latter to the functional absorbing system is shown to be intimately related to the balance between the demands of the shoot and the external supply, but there are outstanding problems in connexion with root cortex which still remain to be solved.

623. JOHNSON, J. 581.144.2 : 632.3/4
Relation of root pressure to plant disease.
Science, 1936, **84** : 135-6, bibl. 1.

It is pointed out that the internal water relations of a host plant as determined by root pressure may be an important determining factor in predisposition to infection and development of disease. Tomato and tobacco plants, for example, when water-soaked by the direct application of high-water pressure to the root system, become highly predisposed to infection with *Bacterium angulatum* Fromme and Murray, though normally infected with difficulty. Increasing root pressure by means of simultaneous exposure of plants to a high soil temperature and a low air temperature, with the evaporation power of the air at a minimum, has produced similar, though less striking, results.

624. ZIMMERMAN, P. W., AND HITCHCOCK, A. E. 581.144.2 : 577.15.04
The response of roots to "root-forming" substances.
Contr. Boyce Thompson Inst., 1935, **7** : 439-45, bibl. 5.

Aerial roots produced by an unnamed species of tropical grape, *Vitis* sp., growing in a glasshouse, did not branch, unless severed, until they came in contact with soil or other moist material.

When lanolin preparations of α -naphthaleneacetic acid, indolebutyric acid, indoleacetic acid, indolepropionic acid, Δ -(3-indolyl)-valeric acid and phenylacetic acid were applied to the root tip region, root elongation was retarded, the root tips became swollen, and branch roots appeared through the epidermis in 3-5 days. Immersion of the ends of the roots in water solutions of the same substances evoked similar responses. When these branch roots were about $\frac{1}{8}$ inch long the main root appeared to recover and renewed its growth, inhibiting further growth in the newly initiated roots. This apical dominance was overcome, however, by re-treatment of the tip with the lanolin preparations or by immersing it in water, and the branch roots renewed their growth until, when about $\frac{1}{2}$ inch long, they apparently became free from further influence of the main root tip and continued to elongate as normal roots. The application of the growth substances to sections of the roots above the region of elongation proved comparatively ineffective, indicating either that the material failed to penetrate the root or that old tissue is less susceptible than that of the growing region. When the substances were applied at nodes or internodes of the stems, especially within the region of elongation, abundant root formation again occurred in the treated areas. The response of the vine shoots differed from that of the roots, however, in that root formation was best induced from 4 to 6 nodes behind the growing tip. Since each of the chemical compounds tested induced root formation on stems and on roots themselves, it is concluded that they must all be true root-inducing substances.

625. DEUBER, C. G. 581.144.2 : 632.184 : 631.542
Effects of pruning the roots of gas-injured trees.
Amer. J. Bot., 1936, 23 : 432-3, bibl. 5.

The roots of small oak trees were placed in water into which measured volumes of a commercial illuminating gas were passed. Within six weeks definite symptoms of injury to roots, buds and foliage were noted. The most injured distal portions of the tap and fibrous roots of half the trees were pruned, and the trees were repotted in soil and observed for two years. Pruning of the roots checked the progress of decay in the roots, and from the vicinity of the callus formed on the tap roots new, vigorous lateral roots were formed. The tops of the pruned trees showed no measurable improvement over those of the controls in two years. [Author's summary.]

626. HITCHCOCK, A. E., AND ZIMMERMAN, P. W. 577.15.04 : 581.14
Absorption and movement of synthetic growth substances from soil as indicated by the responses of aerial parts.
Contr. Boyce Thompson Inst., 1935, 7 : 447-76, bibl. 18.

The application of hetero-auxin, indolepropionic, indolebutyric, naphthaleneacetic, phenylacetic and phenylpropionic acids to the soil induced all the responses in tomato and tobacco plants obtained previously* when the same substances were applied in lanolin, water or oil to the aerial parts of the plant. In addition soil application proved the most effective method for causing systematic bending and rooting responses in these plants. The influence of light on the bending of stems and the premature flowering of Turkish tobacco following soil treatments are responses not previously reported. The responses are described in detail, and the conditions affecting the absorption and movement of the synthetic growth substances in the plant are discussed. The authors also discuss the bearing which their results have on the absorption and transport of materials in general, and on certain practical applications with reference to the rooting of cuttings. Experiments with cuttings from treated woody plants are now in progress.

627. OZEROV, G. V. 631.829
Influence of carbon dioxide on plant growth. [Russian, English summary.]
Soviet Subtropics, No. 4 of 1936 (20), pp. 47-51, bibl. 4.

Experiments showed that the effects and after effects of carbon dioxide increase the growth of the medicinal herbs, basil and valerian. An increase of CO_2 concentration up to 0.36% increased the essential oil content of camphor basil.

* *Ibidem*, 1935, 7 : 209-29, *H.A.*, 1935, 5 : 4 : 521.

628. SNOW, A. G. 581.11 : 631.83

Transpiration as modified by potassium.

Plant Physiol., 1936, 11 : 583-94, bibl. 17.

Plants (sunflower, tobacco, bean) placed in a nutrient medium lacking potassium showed decreased transpiration rates. When sodium was substituted for potassium the influence on the transpiration took longer to develop than in the media in which potassium was absent. The greatest decreases in transpiration of potassium-starved plants occurred when environmental conditions normally increase transpiration. Possible explanations for the observed experimental facts are given.

629. WATSON, D. J. 633.491 : 581.192 : 631.83

The effect of potassium chloride on the diurnal changes of the carbohydrates of the potato leaf.

Ann. Bot., 1936, 50 : 59-83, bibl. 12.

The experiment here described was carried out at Rothamsted with the variety *Ally*, and it was so arranged that an estimate of error could be made. The results are discussed and tabulated in detail and the author gives the following summary :—1. Significant diurnal variations were found in the reducing sugars, sucrose, and starch of potato leaflets. The fluctuations of reducing sugars were small but regular. Sucrose was present in larger amount than reducing sugars and showed greater variation. 2. There was evidence that the change from light to darkness induced a rapid accumulation of sucrose derived from starch, and some indication of the reverse effect in the change from darkness to light. 3. The only significant effect on the carbohydrates estimated of application of KCl was a marked reduction of sucrose during the middle of the day. Starch and reducing sugars were not affected. 4. It appears probable that these effects (2 and 3) were related either to variation of the intensity of illumination, or of water content, but it is not possible to discriminate between these, or other possible causative factors, from the results of the present experiment. 5. The rate of translocation of carbohydrate during the period of darkness was unaffected by application of KCl, but the rate of removal of dry matter was increased. 6. Assuming that the rate of translocation of carbohydrate was also unaffected at other times, the rate of photosynthesis was increased by increased supply of KCl during the afternoon, but was decreased in the early morning. It is suggested that the efficiency of the photosynthetic mechanism was increased by application of KCl, and that the decrease in the early morning was caused by some secondary factor, such as later stomatal opening. 7. The water content per 100 gm. dry matter was increased by application of KCl, and the increase did not vary with time. The loss of dry matter over the sampling period increased with increasing KCl supply, and this was associated with an increased loss of water. 8. The use of the residual dry matter basis of expressing the carbohydrate changes would have given inaccurate results in this experiment, since significant changes in residual dry matter were found.

630. LEMMON, P. 633.491 : 631.415

Respiration of potato tissue in relation to hydrogen-ion concentration of a surrounding solution.

Amer. J. Bot., 1936, 23 : 296-302, bibl. 16.

A study has been made of the respiratory rate of small rods of potato tissue suspended in buffer solutions at intervals of 0.5 pH and covering the entire range from pH 1.5 to 9.5, inclusive. This has been based on measurements of oxygen consumed in respiration obtained by the Warburg manometric method. When using Na_2HPO_4 -citric acid buffers from pH 2.0 to 8.0 inclusive there is obtained a region of hydrogen-ion concentration which corresponds to a maximum point of respiratory activity. In calculations of the hourly rate of respiration from determinations made during periods between 1 and 2, 2 and 4, and 4 and 8 hours of exposure to the buffers, the maximum region of respiratory activity shifts from the neighbourhood of about pH 5.2 to about pH 3.5 and thence back to about pH 4.5, respectively, with the time periods as stated and in the same trials. The magnitude of respiratory rate at the maximum point during each of these intervals of exposure is about the same. The reason for this shift

of pH which corresponds to a maximum point of respiratory activity is not known. Disregarding a "salt effect" at pH 3.5 during shorter periods of exposure, due probably to concentration, respiratory rates gradually rise as the buffers are shifted from pH 1.5 to 3.5 when using an HCl-Na citrate buffer system. The magnitudes of respiratory rates and the general shape of the curve falls in line with the results obtained when using the Na_2HPO_4 -citric acid system in determinations after a period of 2 hours' exposure. When using borax-boric acid buffers, there is a slow and gradually increasing stimulation in respiratory rate as the pH is changed from 7.5 to 9.5 in determinations during periods of exposure less than 4 hours. In determinations during periods of exposure between 4 and 8 hours, however, there is a gradual decline in respiratory rate as the buffers are changed from pH 7.5 to 9.0. A slight stimulation is again noted as the pH is changed to 9.5 in this period. Magnitudes of respiratory rate when using this buffer system are somewhat greater than when using Na_2HPO_4 -citric acid buffers. There is a shift in pH of the buffer solution in which the potato tissue has been suspended. Under conditions of high initial acidity the shift is toward greater alkalinity, and, conversely, under conditions of high initial alkalinity the shift is toward a more acid condition. There is practically no reaction change between initial concentrations of pH 5.0 and 7.0. Variations between 14 controls suspended in physiological salt solution and each made from a different batch of tubers are within reasonable limits of error. [Author's summary.]

631. SCHAPPELLE, N. A. 612.014.44 : 581.16
Effect of narrow ranges of wave-lengths of radiant energy, and other factors, on the reproductive growth of long-day and short-day plants.
Mem. Cornell agric. Exp. Sta., 185, 1936, pp. 33, bibl. 30.

Red and blue lights are of approximately equal effectiveness in bringing about reproductive growth response in radish, spinach, *Crepis* and *Marchantia*, while blue light causes flowering in lettuce sooner than red. Normal long-day plants such as radish and *Marchantia* can be made to fruit during winter by increasing the intensity of natural light during a 10 hour day, particularly if red or blue light is used. Temperatures from 10°-20°C. hastened the initiation of reproductive growth in the plants tested, while higher temperatures from 25°-30°C. caused more vigorous vegetative growth. Reproductive growth was retarded by mineral nutrients, but the subsequent flowering response was eventually greater, if the nutrients aided by proper light treatment had increased the vigour of the plant. Some short-day plants such as aster and early flowering cosmos were not very sensitive to the photoperiod. Others, e.g. *Salvia splendens*, chrysanthemum and *Kalanchoe* sp., Maryland broad-leaf tobacco and teosinte, would not flower in any of the long-day exposures but flowered well with exposures of 5 hours of daylight followed immediately by 5 hours of red light or with 10 hours of daylight. Flowering was, however, practically inhibited by a short day of 5 hours daylight and 5 hours blue light. Thus the reason for the non-flowering of short-day plants during the summer may be not only because of the photoperiod but also because of the high intensity of blue light at this time of the year. Conversely the low intensity of blue light in winter may be partly the cause of the non-flowering of the long-day plants. Either end of the visible spectrum given in the complete absence of the other caused abnormal growth and injury to the plants tested. Blue light except to lettuce was the more harmful. In conducting such experiments the plants used should be raised in white light. In monochromatic light treatments white light should occasionally be given to keep the plants normal. When this was done the different responses were the more easily observed. The technique and the apparatus used in these experiments are described and their probable increase in accuracy over those used by previous investigators is suggested.

632. STEINBERG, R. A., AND GARNER, W. W. 612.014.44 + 551.52
Response of certain plants to length of day and temperature under controlled conditions.
J. agric. Res., 1936, 52 : 943-60, bibl. 10.

Soya bean, sugar beet, and *Rudbeckia bicolor* Nutt. were used to compare plant responses to the daily light period under rigidly fixed environments involving artificial illumination with results

previously obtained under more or less natural conditions, and to make a direct study of the interrelation of day length and temperature as ecological factors. The results agreed closely with those previously obtained with natural illumination under comparable conditions. Flowering and fruiting were favoured in late-maturing soya beans by a combination of short day and warm temperature, in *Rudbeckia* by a combination of long day and warm temperature and in sugar beet by a combination of long day and cool temperature. The interrelationship of length of day and temperature is indicated by the fact that the critical light period for flowering may be altered to a limited degree by a change in temperature, and, conversely, the favourable temperature range for flowering may be shifted by the action of day length.

633. MATZKE, E. B. 581.148.2 : 612.014.44

The effect of street lights in delaying leaf-fall in certain trees.

Amer. J. Bot., 1936, 23 : 446-52, bibl. 23.

Observations made in the autumn of 1935 indicate that street lights in the city of New York cause certain trees to retain some of their leaves for at least a month beyond the normal time. It was found that in certain cases a relatively weak light at a distance of as much as 45 feet from the tip of the nearest branch caused retention of numerous leaves. Similarly a light intensity as low as 1 foot candle at the end of a branch proved effective. The orientation of the light with respect to the tree, that is, its position north, south, east, or west of the tree, was of no significance. In nearly every case of light sensitive species the illuminated parts of the tree retained their leaves, while the shaded parts did not. Species, in which defoliation was clearly affected by light, included Carolina poplar, *Populus canadensis*; London plane, *Platanus acerifolia*; sycamore, *Platanus occidentalis*; and crack willow, *Salix fragilis*. Leaves of the *Populus* and *Platanus* species remained green for an unusually long period when receiving additional illumination. In *Populus canadensis* all of the leaves ultimately fell, abscission apparently taking place at the base of the petiole. In the two *Platanus* species, however, some leaves were retained until killed by low temperatures, and then some of these broke off above the base of the petiole. Of several other species examined the Norway maple, *Acer platanoides*, gave evidence of a response to artificial illumination in some cases, but not in others, and no convincing evidence of a response was obtained in *Acer saccharinum*, *Ulmus americana*, *Tilia cordata* and *Quercus rubra*. It is pointed out, however, that the observations were not started until the end of October, and a study made earlier in the autumn is desirable before it can finally be concluded that these species do not respond to street lights.

634. WEBBER, I. E. 546.27 : 581.8

Histological characteristics of plants grown in toxic concentrations of boron.

J. agric. Res., 1935, 50 : 189-94, bibl. 17.

Histological characteristics of boron-injured lemon, grape, prune and apricot leaves, and prune, peach and apricot stems are here described with the aid of plates. The study makes it clear that both macroscopic and microscopic manifestations of boron toxicity which are characteristic of some plants are lacking in others, and from this it is concluded that a toxic concentration of boron in the nutrient solution is not a stimulus to a specific reaction reflected as a specific alteration in histological characteristics. The histological manifestations of boron injury were found to be similar to those attributable to other causes. Thus the enlarged nodes of boron-injured stone-fruit trees were not unlike those of prune twigs affected with exanthema, and lysigenous gum ducts apparent in the same trees have also been induced elsewhere by a wide range of other stimuli, including certain fungi, bacteria, insects, chemical substances and wounds. This is held to suggest that the observed abnormalities in boron-injured plants may be correlated with the inherent capacity of the species to respond to stimuli. It is thought probable that an excessive concentration of boron in the cell often injures the protoplast to such an extent that it undergoes a progressive degeneration. Chloroplasts, when present, are first affected, and the pale green areas, frequently bordering the brown spots of boron-injured grape leaves, are attributed to the conversion of chloroplasts into leucoplasts. In some instances also an excess of boron may stimulate the protoplast to abnormal growth or division.

635. ANON. 546.27 : 581.1
Boron and plant life.

Publ. Boron agric. Bur., 1936, pp. 18, bibl. 54, reprinted from *Fertil. Feed. St. J.*, 1935, Dec. 4 and 18; and 1936, Jan. 1 and 29.

This paper is a review of the literature on the part played by boron in plant physiology, and the extensive biography should prove of considerable value. Following upon an historical survey, which includes an account of the American borax scare of 1916 to 1924, the modern application of boron to fertilizing problems is discussed at some length. Particular attention is paid to papers dealing with the beneficial effects of boron in combating such diseases and disorders as heart and dry rot of sugar beet, "bog disease" of barley, turnips, clover and potatoes in Austria, "Vatersott" of Kohl-rabi in Norway and brown heart of swedes.

636. NIEMANN, C., AND OTHERS. 581.192
Isolation and determination of starch in plant tissue.
Plant Physiol., 1935, 19 : 579-80, bibl. 5.

A technique is described, whereby starch may be removed from plant tissues by dispersion through the agency of hot dilute ethanol, after suitable pretreatment with an acid-alcohol reagent.

637. FRAZER, J. 581.192 : 546.22
Sulphur content of plants.
Plant Physiol., 1935, 10 : 529-35, bibl. 16.

Literature on the amount and function of sulphur in plant tissues is reviewed. The investigation reported briefly here was concerned primarily with a study of the degree to which plants are capable of absorbing sulphur from prevailing atmospheric gases. Sulphur contents of the leaves of a number of coniferous and deciduous trees, including apples, and of herbaceous plants, including cauliflowers and ornamentals, are tabulated. Analyses revealed only slight variations in sulphur content whether the specimens were taken during the dormant or growing seasons. They also indicated that certain species, when obtained from areas where there is distinct atmospheric contamination from factories, chimneys, etc., contain several times as much sulphur as corresponding species growing in areas which are little or not affected by atmospheric pollution.

638. FREAR, D. E. H. 581.45
Photoelectric apparatus for measuring leaf areas.*
Plant Physiol., 1935, 10 : 569-74.

An apparatus is described for the measurement of leaf areas by means of the photoelectric cell. The chief advantages of the method are its rapidity and simplicity, with a high degree of accuracy. The methods of standardization and calculation are given in detail. The apparatus has been used to determine the area of more than 10,000 apple leaves, with an error of approximately 3%. [Author's summary.]

639. VELTMANN, G. H. 577.15.04 + 581.03 + 581.04
 Physiologische Möglichkeiten der Wachstumsförderung bei Pflanzen durch chemische und physikalische Reizmittel, die nicht "Kernnährstoffe" sind.
 (Physiological possibilities of promoting plant growth by chemical and physical substances which are not themselves plant nutrients.)
Forschungsdienst, 1936, 1 : 836-48, bibl. 57, and 916-30, bibl. 107; and 2 : 26-38, bibl. 94.

The author deplores the confusion that exists in the nomenclature of the various substances, which are not plant nutrients, but which by their presence promote plant growth. He does not

* See also *J. agric. Res.*, 1935, 50 : 637-43, *H.A.*, 1935, 5 : 3 : 333.

consider the time to be ripe for a final classification but he thinks that the following may serve to differentiate the different substances so far as our present knowledge of them reaches. *A. Substances of plant origin which promote plant growth* or "growth substances", e.g. auxin, heteroauxin, bios, biotin, various root excretions, etc. *B. Substances not of plant origin which promote plant growth* (chemical influences):—(a) hormones—the working of 7 of which is discussed; (b) dyestuffs; (c) narcotics; (d) other organic substances, e.g. acetone, petrol, benzol, toluol, etc.; (e) (1) stimulants proper, namely the following metals:—Lithium, rubidium, caesium, copper, magnesium, zinc, mercury, boron, aluminium, titanium, germanium, lead, arsenic, vanadium, sulphur, chromium, molybdenum, tungsten, fluorine, bromine, iodine, manganese, nickel; (e) (2) apparent stimulants, i.e. chemicals used for seed pickling whose influence is due to disinfection of the seed, e.g. H_2SO_4 ; (f) biocatalysts, i.e. substances which are primarily used for such a purpose as seed disinfection and are consequently deposited in the soil, where they must affect the soil microfauna and -flora. *C. Growth promoting measures* (physical influences), namely radiation with growth promoting rays. The author gives brief notes of present knowledge of the effects of all the above substances on plant growth. To a student of any branch of the subject the comprehensive bibliographies together with the notes on particular parts of it should prove useful, especially the section on the effect of metals. Some of the recent literature on hormones is not included.

640. SMITH, H. F. 581.084.2: 519
The problem of comparing the results of two experiments of unequal errors.
J. Counc. sci. industr. Res. Aust., 1936, 9: 211-2, bibl. 4.

This problem arises for example when it is necessary to compare the relative yields of a number of varieties grown in different years or when grown in large agricultural plots or small nursery plots. If the two experiments to be compared have unequal errors, combination in a single analysis of variance is not permissible. The paper describes a method of testing the significance of the interaction of varieties with experiments, based on Fisher's Z test. J.L.E.

641. COCHRAN, W. G., AND WATSON, D. J. 581.084.2
An experiment on observer's bias in the selection of shoot-heights.
Emp. J. exp. Agric., 1936, 4: 69-76, bibl. 1.

Out of 12 observers all with some training in sampling, not one succeeded in picking a representative sample of the material (growing shoots of wheat in this case), and all except three obtained large bias in estimating the quality, as shown in mean shoot height, which was being measured. The observers were not even consistent throughout the experiment. From the results of this experiment, which are supported by evidence from investigations, it is argued that random sampling in which every sample in the population has an equal chance of being picked is the only method for securing complete impartiality. The presence of observer's bias in sampling results greatly detracts from their value, and the provision of reasonably quick methods of taking proper random samples in cases where the material is difficult to handle or demarcate is an important problem in applying statistical methods to agriculture.

642. SUBRAHMANYAN, V. 681.849
Some aspects of composting town refuse with sewage and night-soil.
Agric. Live Stk. India, 1936, 6: 441-50, bibl. 14.

The conversion is described of municipal waste including night-soil into odourless organic manures by packing the material into closed brick or clay cisterns after a short preliminary aerobic fermentation in the open. [A fuller abstract of another article on the same experiment by one of the co-workers appears in the last quarterly issue *H.A.*, 1936, 6: 3: 431.—ED.]

643. NIKLEWSKI, B. 631.417.2
O biologicznie czynnej prochnicy. (On biologically active humus.) [Polish, English summary.]
Roczn. Nauk rol., 1934, 33 : 371-82.

Water extract of cattle manures added to water cultures has a strongly stimulating effect on the growth of plant roots, which has been explained by the author as due to the activity of colloid humus substances present in such an extract. In the present experiments 5 tests with manure that had undergone hot fermentation indicated that this method does not secure nitrogen better than manure preserved on the cool principle. The hot fermented manure had, however, twice the amount of water soluble humus and this is most largely formed when the manure has a preliminary stage of loose packing prior to being compressed. The higher productivity of fermented manure and the better utilization of its components by plants is thus explained.

TREE FRUITS, DECIDUOUS.*

644. ARMSTRONG, W. D. General. 634.25
A fertile type of Hale peach found in central Georgia.
Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 290-2, bibl. 3.

An account is given of the discovery and testing of several trees of a self-fertile type of Hale peach growing in an orchard in Georgia. The fruit of this Georgia Hale is slightly larger on the average than that of Elberta or Hale, but in most other respects appears to lie intermediate between the fruits of these two varieties.

645. ANON. 634.22
Plums and damsons.
Advis. Leaflet. Minist. Agric. Lond., 268†, 1936, pp. 4.

Brief notes are supplied on rootstocks for plums, soils, preparation of the land and planting, pruning, winter spraying, manuring, pollination, and varieties, early, mid-season and late, with statements as to whether they are self-fertile or with lists of suitable pollinators. A very short section is devoted to damsons.

646. ALDERMAN, W. H. 634.1/8-1.521
Accomplishments in fruit breeding by state and federal experiment stations.
Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 13-20.

Answers to a questionnaire sent out to experiment stations in the U.S. in 1935 indicated that 32 State and 13 Federal stations were actively engaged in work on fruit breeding. 18 of these stations have between them, so far, named and introduced 449 new varieties, 321 of which have come out since 1920, and the introductions cover more than 40 kinds or types of fruits. In this paper the experiment stations are listed with notes as to the breeding work in progress and with the names of varieties introduced by each. In his introduction the author criticizes a tendency to release promising new types before they have been fully tested, and a lack of co-ordination between the various phases of breeding projects and of co-operation between workers at the different stations concerned, and he makes suggestions as to how matters might be improved.

647. ANON. 634.26
The cultivation of nectarines in cold houses.
Advis. Leaflet. Norfolk C.C. Dep. hort. Education, 1 of 1936, pp. 11.

The nectarine flowers early and is subject to damage by spring frosts. This risk can be eliminated by growing the trees in pots, or in prepared borders, under glass. In this leaflet notes are

* See also 920, 921.

† Formerly Leaflet No. 350.

supplied on types of houses, construction of borders, drainage, soil preparation, planting, cultural treatment, manuring, picking, on varieties, early, mid-season and late, and on the control of diseases and pests. Particular attention is paid to methods of training, pruning and disbudding, and the instructions in the text are accompanied by diagrammatic illustrations.

648. VAN CAUWENBERGHE, M. E. 634.22
 Enquête sur les variétés de prunes cultivées dans la province de Liège. (Plum
 varieties grown in the province of Liège.)
Fruit belge, 1935, 3rd Year, No. 18, pp. 67-96.

This paper is divided into four main sections:—(1) Plum growing. A general account is given of suitable soils and sites, methods of cultivation, harvesting, pruning, manuring, propagation and of the control of pests and diseases. In propagating vigorous varieties, which make strong stems, budding or grafting may be done at ground level, but where weak varieties are used the stock should either be allowed to grow for another year to form the trunk when budded high, or double working may be employed using a strong intermediate. Stocks normally raised from seed include Saint-Julien and Damas. Myrobalan is raised from seed or cuttings, but should be abandoned as a stock. [No particular reason is given.—ED.] To obtain uniform trees, however, and, in particular, to obtain rootstocks adapted to different soils, varieties and methods of cultivation, it is necessary to use clonal stocks propagated by vegetative means. Brompton and Damas type C are suggested as vigorous stocks, Common Mussel as a stock of moderate vigour, and Saint-Julien type A as a rather dwarfing stock. The last two are recommended for bush-trees. (2) A list of recommended varieties for dessert and culinary purposes. (3) A list of varieties arranged in four groups according to their times of flowering. (4) Detailed descriptions of the 25 principal varieties, and brief descriptions of a few varieties of limited local interest. The descriptions of the better known varieties are based largely on those given in "Les meilleurs fruits au début du XXe siècle" by the Société Nationale d'Horticulture de France, and in "Le catalogue descriptif des fruits", which was adopted by the Société Pomologique de France.

649. WIEGAND, E. H. 634.22
 Factors responsible for prune quality.

Proc. annu. Mtg. Ore. St. hort. Soc. for 1935, 50, being 27th annu. Rep., pp. 92-8.

In a lecture to growers the author discusses the factors responsible for prune quality under the following principal headings:—Orchard practices, with a subsection devoted to the control of brown rot; preparation practices and their improvement; drier types, and drier conditions, such as temperature, humidity and air circulation, and their influences on drying and quality.

*Propagation.**

650. DE WET, A. F., AND MICKLEM, T. 634.1/2-1.541.11
 Fruit tree investigations.
Fmg. S. Afr., 1936, 11: 337, 348.

The experimental work at the Stellenbosch College of Agriculture to discover fruit tree rootstocks suitable to various South African conditions is discussed. Stocks of standardized types have been imported from East Malling and from Long Ashton in England, and from Germany and elsewhere, while local stocks are also on trial. The work at present is essentially preparatory, since all these stocks must be vegetatively propagated in quantity before the experiments proper can start. This is being done in a variety of ways in the endeavour to find those most suited economically as well as practically to the subject. Some varieties, e.g. peaches, give best results from soft wood cuttings under glass. Nurse roots have been extensively used, in which 2-3 inches of root $\frac{1}{4}$ - $\frac{1}{2}$ inch in diameter is whip and tongue grafted with a raffia tie on to the side of the

* See also 659.

cutting and the grafted cutting planted. In a year it is dug up and, if the cutting has produced roots of its own, the foreign root is removed and the cutting replanted. This method is only regarded as a makeshift until a more economically successful method can be developed. During 1936 5,000 standardized stocks have been budded to pear and stone fruits for compatibility tests and field trials. The number of different varieties under observation of all kinds of deciduous fruits is very considerable. The stub grafting method of topworking has proved very successful.

651. VON VEH, R. 631.52 : 634.1/2
 Eine neue Methode der Anzucht von Sämlingen, unabhängig von Ruheperioden und Jahreszeit (bei Äpfeln, Birnen, Quitten, Pflaumen, Kirschen). **(A new method of raising, irrespective of rest period and season, seedlings of apple, pear, quince, plum and cherry.)**
Züchter, 1936, 8 : 145-51, bibl. 2.

The process described is as follows :—Freshly harvested apple, pear or quince seed may be treated at once or kept in tap water for 1 to 2 days. The operation consists in removal of the seed coat (outer and inner integument) and of the nucellus, a thin white skin of living tissue. The embryos so disclosed are placed in a petri dish containing tap water where they remain just covered with water for 5-6 days at ordinary room temperature and light, direct sunlight being avoided. At the end of this time the embryos, most of them still white with occasional green patches showing, are transferred on wood wool to granulated cork* (about the size of rye grains) floating in a dish for which a glass cover is provided. Development is best in a saturated atmosphere. The cork grains swell up after a few days and form a good platform. After 5-6 days here the embryos develop rapidly becoming quite green and sending out root and hypocotyl. If the cork has swollen so much as to prevent the root making its way through to the water, a passage should be made for it. In water at about 18°C. (64.4°F.) a strong tap root and subsidiary roots will have formed in 10-14 days, and above the cork layer the first and second pair of foliage leaves will have unfolded. Directly the green of the seedling begins to turn dark, ventilation is necessary preparatory to submission to greenhouse atmosphere between the 10th and 14th day. At this stage the seedlings are planted into a mixture of equal parts of sand and peat. (This is much more successful than direct planting into compost earth.) There they stay until sufficiently hardened [apparently about 1 week to 10 days.—ED.], after which they are removed into deep trays of compost earth. Seeds of apples, pears, plums and cherries, which were thus stimulated into germination in August and September 1935, developed several pairs of leaves in the room where they were, but in November-December they ceased action and even under the influence of artificial lighting no further buds could be induced to unfold, although growth of existing leaves proceeded under this stimulus. All these seedlings were submitted each day from 12 October to 20 December to a regular and exclusive illumination by electric burners. On the 20 December they were removed to a glasshouse and from 2 January to 7 February they received additional Neon lighting to make their whole illuminated period up to 15 hours a day. Neither intensity of light nor increased moisture and warmth resulted in the desired growth renewal. Hence on 14 February they were planted out in the nursery and left to the mercy of frosts. On 23 March they were brought back into the glasshouse and provided with light, warmth and moisture. The buds started to break within a few days. Meantime the seedlings had discarded all their first leaves and on 1 April they began their second growing season. The behaviour of all seedlings irrespective of species was the same. It is thought that these methods may be of great use to the breeder. It is noticeable that whereas in previous, somewhat similar experiments by Flemion (*Contrib. Boyce Thompson Inst.*, 1934, 6 : 205-9, *H.A.*, 4 : 4 : 519) the seedlings were initially dwarfed and abnormal in appearance—though later normal—, in von VEH's experiments no such abnormality was observed.

* This has proved much more satisfactory than soil, sand, peat or sawdust.

652. LEIB, E. 631.541 : 634.1/7
 Ueber den physiologischen Einfluss schädlicher Baumwachse auf Pflanzengewebe und dessen Bedeutung für die Veredlung von Obstgehölzen. (**The physiological influence of harmful grafting wax on plant tissue and its importance in grafting fruit trees.**)
Gartenbauwiss., 1936, 10 : 256-78, bibl. 17.

The author describes the disturbances of the tissues which occur in graft unions on top worked apple trees and in grafted *Pelargonium zonale*, with special reference to the influence of different grafting waxes. Broadly speaking the requisites normally demanded of a good grafting wax are that it shall adequately cover the wound and shall not be affected by the weather. If these requisites are not fulfilled, atmospheric factors are likely to become important and harmful. At the same time the chemical and physical properties of the wax are found to be very important. Investigation of the results of a comprehensive tissue destruction (unconnected with gum formation and necrosis in the callus region between scion and stock) due to harmful wax leads to an understanding of the sudden failure of grafts a long time after grafting. The extent and speed of tissue destruction due to wax is chiefly due to two factors, (1) the chemical harmfulness of the wax and (2) the fluidity of the wax. The point at which tissue destruction begins is also important. If the wax is harmful, the smooth top of the stock affords it an excellent sphere of action and the living tissue is from here quickly stimulated into gum formation and subsequent death. This breaking down of tissues gradually spreads to the scion and, with the final cutting off of food supplies as the result of the vessels being blocked by gum, the scion dies. This work of disintegration goes on without necessarily giving any outward symptoms and becomes greater, the more harmful and irritating the chemical nature of the wax is and the more fluid the wax. The histological disturbances which occur are shown diagrammatically. The author recommends that wax should not be chosen merely for its covering and weather resisting qualities but rather according to the effect of its constituents on the living tissue. Any wax whose constituents are likely to be harmful should be rejected.

653. ANON. 634.1/2-1.541.44
Modern methods of top grafting fruit trees.
Advis. Leaflet. Norfolk C.C. Dep. hort. Education, 4 of 1936, pp. 15.

Methods of top grafting have been investigated at the Norfolk County Council's Horticultural Experimental Stations at Burlingham and Emneth during recent years. Nearly all apples and pears can be satisfactorily top grafted, but stone fruits, unless the trees are very young, are more difficult. Apple varieties which are somewhat unreliable include Emneth Early, Lord Grosvenor, Lord Suffield, Newton Wonder and Ribston Pippin. Experiments have shown that high grade bitumen emulsions, of a heavy consistency, are preferable to any existing form of grafting wax or tape binding as a protective covering for the grafts. Four formulae are given, however, for home-made grafting waxes which have been found satisfactory. Four systems of grafting are described, and each is clearly illustrated by diagrams:—(1) Crown or rind grafting. (2) Herringbone grafting. (3) Stub grafting and (4) whip and tongue grafting, which may be used to furnish stub or herringbone grafted trees with new leaders.

654. YEAGER, A. F. 634.11-1.542.3
Trunkless apple trees.
Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 39-40.

Bush or trunkless apple trees, formed by heading at ground level, are now accepted as the desired form for all varieties growing in North Dakota. Comparing 15-year-old standard and bush Hibernal trees it is shown that 70% of the former and 0% of the latter have been winter-killed, and that as regards means of trunk circumference, height, volume and yield the bush trees were superior. A clean cultivation and barley cover crop system of culture is adopted in the orchard and these trunkless trees offer no particular difficulty in cultivation, while pruning, spraying and picking are all facilitated.

655. MAURER, E., AND REDECKER, W. 634.1/2-1.541.5
 Vergleichende Versuche an Obstokulanten (einjährige Veredlungen) zwischen
 den Zapfen- und Leittriebklammer Methode, and Weitere vergleichende
 . . . , etc. (**A comparison of the old stub method of budding with a new
 method in which a patent guide clip is used and the stub eliminated.**—Parts
 1 and 2.)
Landw. Jb., 1933, **77** : 345-66 and 1936, **82** : 1001-9.

In Germany, where the more normal practice is to leave a stub to which the new shoot which proceeds from the bud is bound, experiments have been made with a patent steel clip* which is fastened round the stem at the time of budding, and forms a shield behind the bud which acts as a guide to the new shoot. The stub is removed and it is claimed that better unions result and better callusing over the wound made by the removal of the stub, which in this case takes place in spring. It also obviates any chance of injury to the new growth due to careless removal of the stub in autumn. It is pointed out that the operation with the clip is very simple and much shorter than that involved in tying with bast, which operation is, of course, eliminated. Further labour involved in examination of ties, and their loosening, tightening and removal, is also eliminated, only one further operation being necessary after the initial one, namely removal of the clips when the shoot can finally stand on its own. Details are given in the second paper of comparative trials in three different nurseries of the two methods with apples, pears and plums. Considerable success was obtained using the clip especially in the case of apples and pears. Unfortunately conditions of comparison were not very uniform and results obtained are conflicting. It is obvious that the method is no more fool-proof than the old one. It would appear to offer the chance of greater success, if care is taken. Whether the advantages gained outweigh the additional expenditure on the clips, which is apparently greater than that of the labour involved when using raffia and a stub, remains to be proved.

656. ANON. 634.1/2-1.541.44
Reworking of fruit trees.
J. Dep. Agric. Vict., 1936, **36** : 363.

In view of an impending campaign to induce and help orchardists to topwork their trees to commercial varieties a list of 45 such approved varieties is given, those still in the experimental stage being separately distinguished. It is quite possible that some varieties now on the list may eventually be dropped from it and a warning is given against disproportionately heavy planting of any one variety.

657. BALLANTYNE, J. A. 634.1/2-1.541
Bridge grafting and inarching of fruit trees.
Agric. Gaz. N.S.W., 1936, **47** : 448-50.

A method of bridge grafting and inarching which has been found the most simple and practical of a number tried at the Bathurst Experiment Farm is described and illustrated. It is suggested that the bridge graft should be made to stand out from the tree in a bow touching the tree only at the extremities ; this enables the cut ends of the graft to fit flatter in the recesses and provides no harbourage for insects, as does the graft which lies closely along the trunk. With young trees so grafted the bow allows for play in heavy winds and reduces the chance of the graft shifting. With stocks planted beside the tree inarching can be done with any suckers of sufficient size which may be sent up from below the wound on the injured tree. In this case the top end of the sucker is inarched into the tree. Instances are given of cherry trees, whose trunks and main limbs were dying as the result of gumming, being restored in this way.

* Made by Heimann Meyer-Rellingen at Hamburg.

658. BRADFORD, F. C., AND JOLEY, L. 634.11-1.541

An experiment in double working apple trees in the nursery.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 360-5.

Trees budded to Jonathan in 1933 were budded again in 1934 to a sport of Winesap, about 44 cm. high on the Jonathan whips. The intermediate was subjected to four treatments:—(1) All lateral growths were removed; (2) three shoots, averaging five leaves each, were left on the lower half of the intermediate, none on the upper half; (3) three shoots were left on the upper half, none on the lower; and (4) three shoots were left on the upper half and another three on the lower half of the intermediate. Growth measurements were made at fortnightly intervals during the 1935 season. Differences in diameter increments of the top scion appeared early and were maintained throughout the season. Treatment 1 gave the greatest increments and the others followed in order. The most notable difference was that between the first two treatments, in which no foliage was left on the upper half of the intermediate, and the last two in which the foliage was retained on this portion. The relatively smaller differences between treatments 1 and 2, and 3 and 4 indicate an additional, but lesser, depression of top scion growth due to the presence of foliage on the lower half of the scion. Lengths of top scion followed the same order as diameters, but differences did not appear so rapidly. Production of secondary shoots also followed the same order, differences being very pronounced, and, although these were removed promptly, it is thought that they were responsible for the delay in the appearance of differences in length of the main shoots. The upper diameters of the intermediate were similarly affected, the increases from treatments 1 and 2 being significantly greater than those from treatments 3 and 4. In the lower part of the intermediate, on the other hand, the proportionate increases in diameter were nearly the same for all treatments.

Rootstocks.

659. KERR, W. L. 634.1/2-1.541

A simple method of obtaining fruit trees on their own roots.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 355-7.

By grafting* the scions on to the basal ends of seedling piece roots instead of the apical ends, so that the rootstock pieces are in an inverted position when planted out, the production of roots above the unions is stimulated. The stands obtained with a number of apple and plum varieties propagated in this manner at Morden, Manitoba, are tabulated.

660. THOMAS, L. A. 634.11-1.541.11

A survey of the vegetatively propagated rootstocks in the Stanthorpe district.

J. Counc. sci. industr. Res. Aust., 1936, 9 : 233-4, bibl. 1.

To test the identity of the reputed Northern Spy rootstocks on which the trees on the Stanthorpe district are worked with a subsequent marked variability in performance, 245 collections of root cuttings from 93 orchards were planted. In each orchard the cuttings were taken from the largest and smallest trees generally bearing the same scion variety. When grown 94.3% proved to be Northern Spy of the same type. The remainder of different types were stooled and their rooting ability examined. Most of these types were, in the orchard, carrying outstanding trees and a clonal race has been established of the best (S.4) and has been budded to Jonathan for a stock trial.

661. MANEY, T. J., AND OTHERS. 634.11-1.541.11

Stock and clon effects in topworked apple trees.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 332-5, bibl. 3.

The results of experiments with three types of stocks are outlined:—(1) Own-rooted stocks:—Five scion varieties were each budded on to a number of own-rooted stocks and for comparative

* Bench grafting.

purposes were also budded and root-grafted on to a number of French crab seedlings. The different own-rooted stocks had a marked effect on the volume of the scions after 5 years in the orchard, Dudley producing dwarf, Hibernial intermediate, and Virginia Crab vigorous trees. The outstanding feature of the trial, however, was that the coefficients of variability for height, spread, and trunk circumference were, if anything, rather greater for the trees on own-rooted stocks than for those on seedling stocks. (2) Stocks from open pollinated seed from selected seed parents :—Certain parent varieties, including Virginia Crab and Hibernial, were found to produce seedlings so weak as to be worthless, whereas some 9 other varieties out of about 70 tested gave exceptionally good stocks. In 2-year-old Sharon trees, root-grafted on to seedlings of 36 of these varieties, the scion was found to exert a fairly uniform influence on the root type developed, whereas in comparable budded trees sometimes the scion and sometimes the seedling stock dominated root development. The opinion is expressed that the selection of particular seedling stocks may prove to be of importance in the solution of rootstock problems. (3) Double-worked stocks :—Root-grafted trees of Virginia Crab and Hibernial planted in 1924 were limb-budded the following year with 5 other varieties. Measurements of height, spread and circumference were made at the end of the 1934 season. The results indicate clearly that variability in the scion varieties has been reduced to a point considerably lower than that normally obtained in horticultural material, and the authors conclude that, in this particular trial, there is a uniformity in growth brought about by intermediate stem piece effect which is equal to, if not better than, any result which might be anticipated from the use of own-rooted stocks.

662. HEARMAN, J. 634.11-1.541.11
The Northern Spy as a rootstock when compared with other standardized European rootstocks.
J. Pomol., 1936, 14 : 246-75, bibl. 40.

Northern Spy is said by Beach in *The apples of New York* to have originated in a seedling orchard of East Bloomfield, New York. This orchard was grown from seeds brought from Connecticut about 1800. By 1857 Spy was listed by Hogg as a new promising variety from America of the Spitzenburgh family. The author could find no references to any investigational work establishing its blight-proof properties, and where this property is mentioned it is always taken as an accepted fact. It is evident that it was coming into use as an immune stock in Australia in 1890, while its importation into South Africa was specifically allowed by the Agricultural Pests Act of 1911, and in 1913 Southern Rhodesia incorporated a similar clause in its regulations. The first critical tests appear to be those of Staniland in England in 1923 when its immunity to attacks of woolly aphis both above and below ground was definitely proved. Vegetatively propagated Spy is now accepted as immune all over the world. It has in individual instances been recorded as showing some resistance to collar rot and black rot, as free from canker (either owing to immunity to that disease or to immunity to woolly aphis), and to be very susceptible to scab and mildew. It is not easily propagated vegetatively, at least by the stool method or by layering, and the more normal practice of working a piece of Spy root with a piece of Spy stem and then budding with the required scion variety a year later is very cumbersome. Reports of its qualities as a rootstock are not good, as is shown by evidence from Australia, New Zealand, South Africa, U.S.A. and England. Apparently it does not readily adapt itself to uncongenial situations. Its failure under such circumstances would appear to be due to a poorly developed shallow root system involving poor anchorage and great susceptibility to drought. In the illustrated account of observations made on excavated trees from Auckland, New Zealand, and of trees growing at East Malling the author compares in great detail the root system of Spy in the nursery bed and as a rootstock for Grenadier with those of Malling stocks, I, II, IX and IV and of another immune stock, Ivory's Double Vigour, growing in a typical Malling loam of the brick earth series, overlying Kent ragstone. The excavation of some 40 trees gave the general impression that the root system of Spy, when developing unhampered by outside root competition, forms a shape rather like a tin lid. The main scaffolding appears to be shallow and such deep roots as are formed occur near the extremities. It is not naturally

deep rooting, and when it does root deeply this is due to the fact that it cannot stand competition from other roots.

663. LAGASSÉ, F. S.

634.11 : 1.541.11

A comparison of the top and root growth made by five varieties of apples on seedling and scion roots during five years in the orchard.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 366-71, bibl. 4.

The varieties and the number of trees of each employed and results obtained at 2 years old were reported in an earlier paper*. Four points of particular interest arising out of comparisons made at the end of 5 years are here presented. (1) In general the trees of all varieties have made greater net growth of roots and tops on seedling roots than on their own roots. On the other hand, if considered as percentage net gain over original weight the scion-rooted trees have in general made the greatest growth. Great varietal differences developed with respect to the amount of growth made, regardless of the type of root, which indicated that the top possessed a mechanism, varying with variety, and that this controlled to a large extent the amount of growth made. (2) The variability of the net growth made by the scion-rooted trees was, in four of the five varieties, slightly, but not significantly, less than that of the trees on seedling roots. With Yellow Transparent the reverse was true, but again the difference between coefficients of variability was not significant. (3) It was found that none of the correlation coefficients between the original weight of the trees and their net gain in weight was significant, thus indicating that large trees did not remain large, nor small trees small, in all instances. The use of the percentage net gain over original weight as a measure of growth (as noted above in 1) may be criticized on these grounds. (4) The top:root ratio of the seedling trees was in general less than that of the scion-rooted trees. High positive correlations were obtained between the weight of tops and the weight of roots for all varieties, whether scion or seedling rooted, but these data are not presented here. The tops usually weighed about twice as much as the roots.

Rootgrowth.†

664. HEINICKE, A. J.

634.11 : 581.144.2

Root growth in young apple trees made shortly before and after defoliation.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 164-5.

The leaves on the lower portions of the shoots of 2-year-old McIntosh trees growing in 3-gallon pails began to turn yellow about September 1. On September 15 the trees were divided into two lots, one lot being artificially defoliated and the other left to defoliate naturally. The trees were then removed to larger containers, so that the original ball of soil might be surrounded by sand. The root-systems were examined at intervals and roots growing into the sand were recovered and weighed in some cases. The trees defoliated on September 15 made an average of only 2 grams dry weight of new roots compared with 9 grams made by the control trees which retained some leaves for a month longer. This suggests that while trees do make some root growth during the dormant season the amount is relatively small compared to that made several weeks before leaf fall.

Pollination.

665. KRÜMMEL, H.

581.162.3 : 634.1/2

Die Befruchtungsverhältnisse beim Obst. (Pollination in fruit trees.)

Obst. u. Gemüseab., 1936, 82 : 21-2, 41-3.

The author gives a brief account of the different aspects of the pollination problem and a list of common German commercial varieties of apples, pears, sweet and sour cherries and plums, noting their time of flowering and the varieties observed to be good pollinators for them. He notes that work on pollination is being undertaken in collaboration with one another at the

* *Ibidem* for 1931, 1932, 28 : 475-84, *H.A.*, 1932, 2 : 3 : 217.

† See also 622-625, 663.

following German research stations:—Versuchs- u. Forschungsanstalt für Wein- Obst- u. Gartenbau in Geisenheim a/Rhein, Versuchs- u. Forschungsanstalt für Gartenbau in Weihenstephan, Botanisches Institut der Universität Würzburg (Dr. Branscheidt), and Institut für Pflanzenbau u. Pflanzenzüchtung der Universität Halle (Saale).

666. EAGLAND, J. S. 581.162.3 : 638.14 : 632.95

Bee mortality in orchards.

J. Dep. Agric. Vict., 1936, **36** : 299-301.

The great mortality of hive bees and larvae in Victoria has been traced in two districts to arsenic in contaminated pollen. It does not follow that orchards have been sprayed while in blossom, since the pollen may have been obtained direct or have drifted from occasional late blooming trees occurring in orchards that have been sprayed at the proper time, or the ground flora beneath sprayed trees may have been contaminated.

667. MURNEEK, A. E. 581.162.3 : 634.11

Pollination studies with Golden Delicious, Minkler, and Arkansas varieties of apples.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, **33** : 1-3, bibl. 8.

Two pollination trials are described. In the first Golden Delicious was found to compare favourably as a pollinator for four varieties with Delicious (Red), Jonathan and Ben Davis, all of which are recognized as good pollinators in the Central States. In the second trial the pollination requirements of Minkler and Arkansas (Black Twig), two varieties which are erratic in setting fruit, were studied. The paper-bag method was used and the efficiencies of several pollinators and of open pollination were compared. With both varieties a much higher fruit set was obtained from open pollination than from the use of any one pollinator, but it is not known whether this was due to the influence of a number of other varieties which were growing in the orchard, or to some adverse effect from the experimental procedure. Of the individual pollinators Wealthy gave the best set on Minkler, and Jonathan and Delicious gave good results with Arkansas. Grimes pollen, which is satisfactory for many varieties, gave the lowest fruit-set with Minkler and no fruit at all with Arkansas, and in the latter case this confirms results obtained elsewhere, which point to the existence of congenital cross incompatibility between Arkansas and Grimes.

668. KNOWLTON, H. E. 634.11 : 581.162.3

The relative abundance of pollen production by varieties of apples.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, **33** : 7-9.

The number of pollen grains in the anthers of several apple varieties were counted by two different methods. In the first a single anther was allowed to dehisce on a glass slide ruled in squares, and the pollen grains spread out and counted in each square under a microscope. This method proved very slow and laborious, and in two subsequent seasons use was made of the haemocytometer designed for making counts of blood corpuscles. On both occasions random samples of 10 anthers were examined. The results indicate a very wide range of variation of pollen production between anthers of any one variety as well as between those of different varieties. In two successive years Delicious and Starking gave high pollen counts, Cortland and McIntosh low counts, and Grimes a rather low count. The author doubts, however, whether 10 anthers are a sufficiently large sample to provide a close analysis of varietal differences.

Growth, nutrition.

669. SMITH, W. H. 634.11 : 581.192

Anatomy of the apple fruit.

Rep. Food Invest. Bd. Lond. for 1935, 1936, pp. 139-42.

The apples investigated were Bramley's Seedling. A correlation was established between size of cell and size of fruit in a population of apples ranging in weight from 67 to 463 grams. Whereas

the weight of the largest apple was seven times that of the smallest, the cells of the former were only twice as big as those of the latter, which means that the larger fruit has the greater number of cells. A further correlation was established between the weight of apple and the area of total conducting elements in a transverse section through its stem. In the stem at its point of junction with the fruit a marked predominance was found of phloem over xylem. It is suggested that this may be associated with the observed active transfer of organic material from the tree to the growing fruit and also with its relatively slow transpiration.

670. MURNEEK, A. E., AND SCHOWENGERDT, G. C. 634.11 : 581.144.1
A study of the relation of size of apples to number of seeds and weight of spur leaves.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 4-6, bibl. 8.

A study was undertaken to determine to what extent there is a correlation between size of apple fruits, number of seeds per fruit and leaf area per spur. Several hundred bearing spurs were collected at random from the inside (shaded) and outside (not shaded) portions of a large Wealthy tree maturing a heavy crop. The spurs were separated into those with small and large fruits, and determinations were made of seed numbers, fruit weights and leaf weights, which are fairly closely correlated with leaf areas if estimated with little loss of moisture. Good correlations were obtained between weight of fruit and number of seeds and between weight of fruit and weight of spur leaves, but apples from the shaded parts of the tree showed a significantly higher correlation between fruit weight and seed number than those from outside non-shaded parts, although in both cases the smaller fruit gave a higher fruit weight:seed number correlation than did the larger fruit. As was expected there was no correlation between leaf weight and seed number. A tentative conclusion is drawn that with shaded trees and branches a relatively high number of seeds will result in larger apples, whereas with non-shaded trees or branches comparatively larger fruits may be formed in the presence of fewer seeds due to greater average leaf area per spur per branch and a high photosynthetic efficiency of the leaves.

671. TUKEY, H. B., AND BARRETT, M. S. 634.25-1.531
Approximate germination test for non-afterripened peach seed.
Plant Physiol., 1936, 11 : 629-33, bibl. 5.

Peach seeds normally require an after ripening period of 12 weeks at a temperature of a little over freezing before germinating. Germination was obtained in 7 days by removing the hard pit and sterilizing the naked embryos in 2% chlorine solution for 30 minutes, placing them in sterilized $\frac{1}{2}$ oz. bottles on $\frac{3}{8}$ % agar medium. Various other nutrient and agar concentrations inhibited or failed to improve the response. The percentage of seeds germinating from autumn planting under nursery conditions is very similar to that obtained by this culture method before planting.

672. HULME, A. C. 634.11 : 581.192 : 631.84
The metabolism of nitrogen by apple fruits during development on the tree and in storage.
Rep. Food Invest. Bd. Lond. for 1934, 1935, pp. 135-43, bibl. 6
 and
Metabolism of nitrogen in apple fruits.
Rep. Food Invest. Bd. Lond. for 1935, 1936, pp. 111-4, bibl. 2.

The following notes are taken from the author's summary of the first report :—The fresh weight of the pulp continues to increase per apple up to maturity, but the fresh weight of the peel reaches an asymptotic value early in the fruit's development. The change in total nitrogen confirms the results of Archbold and others. The rapid decrease in total soluble nitrogen (as a percentage of total nitrogen) which occurs during the early development of the fruit in both peel and pulp is striking. The final decrease in total nitrogen, protein and soluble nitrogen in the case of the pulp may possibly be connected with the ripening of the seeds. During the climacteric rise in respiration there do not appear to be any violent changes in the total protein

and total soluble nitrogen fractions. An increase of protein during storage at the expense of soluble nitrogen confirms previous findings. Results for the acid-content of the fruit over the period of growth, taken in conjunction with the data for nitrogen show that the acid cannot arise directly from products of the breakdown of protein. The work reported in the second article confirms results for the second and third stages in the development of the fruits on the tree. A fuller investigation of the earlier stages has now shown that there is a steady and marked increase in the relative amount of soluble nitrogen throughout this period. In immature detached fruits a considerable breakdown of protein was found to occur after removal from the tree, but as the apple developed this tendency was found to decrease. Finally a stage was reached where net synthesis of protein took place. It appears probable that this transition is reached just prior to the climacteric. Work was also carried out to test the results on the fruits of injecting various nitrogenous compounds into the tree. The compounds used were ammonium nitrate, asparagine and urea and the date of injection 15 July, the fruits being picked on 17 September. The increase in nitrogen content of fruits was marked, especially in the case of the urea injected trees.

673. JAHN, A. 634.25 : 581.45
 Die morphologische Beschaffenheit des Blattrandes von Pfirsichsorten. (**The morphological character of the leaf margin in peach varieties.**)
Angew. Bot., 1936, **18** : 27-43, bibl. 5.

Peach leaves of some 32 varieties, including English and American, were submitted to careful measurement of the length and depth of the teeth which form their margins and are here classified into 3 groups according to the length of the teeth, the depth of the indentations between the teeth forming 2 subdivisions of these groups in each case. Where the ratio of tooth length to depth (depth of indentation) is very small, e.g. Früh v. Savara 1.8 : 1, or very large, e.g. Sieger 8.08 : 1, these characters form a good means of identification. This ratio would not appear to bear any relation to leaf length : leaf breadth. Tooth length and tooth depth appear to be linked characters, as throughout leaves with longer teeth also possess deeper indentations. A good basis is afforded for the study of inheritance of tooth form, in which the clearest results may be expected by crossing extreme forms.

674. HEINICKE, A. J., AND CHILDERS, N. F. 634.11 : 581.13 : 631.432 : 631.8
The influence of water deficiency in photosynthesis and transpiration of apple leaves.
 CHILDERS, N. F., AND COWART, F. F.
The photosynthesis, transpiration, and stomata of apple leaves as affected by certain nutrient deficiencies.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 155-9, bibl. 2, and 160-3, bibl. 4.

[1] The effect of allowing the soil gradually to dry out on transpiration and photosynthesis in apple leaves was studied in McIntosh, Baldwin and Delicious trees growing in containers in a glasshouse. When the soil moisture was still about 2.2% above its wilting coefficient of 15.5%, some 70% of the stomata opened in the morning but all closed before 2 p.m. On the following morning only a few opened and these soon closed, remaining in this condition for the next six days, by which time the soil moisture was 5.9% below its wilting coefficient. Photosynthetic activity declined gradually in relation to that of control trees from the day upon which the stomata were first closed. The rate of transpiration started to decline somewhat sooner, and declined more rapidly, but with greater fluctuations, than did photosynthetic activity. From this it is concluded that the early closing of the stomata, associated with a reduced water supply to the leaves, tends to conserve water to a greater extent than it reduces photosynthesis. [2] Rates of CO₂ assimilation and transpiration and the frequency and behaviour of the stomata were determined for the leaves of 2-year-old McIntosh trees growing in washed sand and supplied either with full nutrient solution or full nutrient solution minus N, P, K or PK. After 5 months' growth leaves deficient in N were found to be assimilating only about one-third as much CO₂ and transpiring only 70% as much water as were full-nutrient leaves. Leaves deficient in

P, K or PK differed but little from full-nutrient leaves in rates of either assimilation or transpiration, but, as the leaves were smaller in size and showed scorching when K was deficient, the differences between the plants as a whole would be more marked. Leaves deficient in N possessed more stomata and slightly greater pore area at maximum opening than did full-nutrient trees. The reduction in rates of transpiration and photosynthesis are, therefore, thought to be due to the observed sluggish action of the stomata or to some internal factors, including less chlorophyll and an inadequate water supply.

675. HESSE, C. O., AND SCHRADER, A. L. 634.11-1.547.6
Some results with the electrical maturity tester in measuring developmental and ripening changes in the apple.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 210-2, bibl. 1.

This paper is a preliminary report on a project dealing with the picking maturity of apples, especially to determine the earliest possible date on which the fruit may be picked without appreciable loss of quality. In one series of tests with Jonathan and Grimes apples grown in Maryland use was made of the so-called electrical maturity tester described by Moore*. The curve for millimeter readings obtained at weekly intervals showed a gradual downward slope throughout the season until 7-14 days prior to commercial picking dates, and it is thought that, if this relation to optimum picking dates is obtained in future seasons, the usefulness of the method for predicting maturity will be established. Pressure test data and fruit diameter measurements showed fairly constant curves downwards and upwards respectively, but no changes which could be correlated with the changes in the millimeter readings were obtained.

676. TUCKER, L. R. 634.23 : 581.145.2
Additional notes on sweet cherry doubling.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 237-9, bibl. 3.

The production of a high proportion of malformed fruits, mainly doubles, due to abnormal pistil formation is common in certain seasons among the sweet cherry crops in the Western States. A study to determine how localized on the trees the effect might be is briefly reported. An examination of weather records in Idaho over a 5-year period suggests a possible relationship between doubling and high temperatures during the preceding May, or May and the first half of June.

677. LILLELAND, O. 634.21 : 581.14 : 551.52
Growth study of the apricot fruit II : The effect of temperature.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 269-79, bibl. 7.

Previous findings that the growth of the apricot fruit is divided into three well defined periods are confirmed. The fruit at first increases rapidly in size, then much more slowly, and finally rapidly again until maturity. This periodicity is markedly synchronized for all the fruits on a tree, and it has been suggested that growth processes elsewhere in the tree may be the factors controlling the growth of the fruit. By subjecting some of the fruits on a tree to warmer night temperatures in shelters, it was shown, however, that, although the heated fruits still exhibited periodicity in growth, this periodicity was clearly not synchronized with that exhibited by the unheated fruit in the outside environment. It is thought, therefore, that temperature influences are the factors determining the synchronism in growth. Data on shoot growth are also presented to show that the period of slower fruit growth cannot be attributed to any competitive increase in shoot growth during the middle of the season. In addition, the growth of the endocarp, kernel, endosperm and embryo of fruits within and outside the heated shelters is compared, and heat units and base temperatures are calculated for the various periods of growth of the Blenheim apricot fruit.

* See *H.A.*, 1932, 2 : 3 : 229.

678. LANGORD, L. R. 634.23 : 581.145.2
Seasonal influences upon the effect of shading in regard to setting of sour cherry fruits.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 234-6, bibl. 2.

The shading of Montmorency cherry trees with burlap during the period of blossoming caused a distinct reduction in fruit set during five successive years. No relation was established, however, between hours of sunshine and fruit set, but weather records showed that in years of low mean temperatures the trees gave relatively low fruit sets, and the data suggest that some influence of temperature, other than its effect on pollination, was operative.

679. COWART, F. F. 634.11 : 581.144.1
Apple leaf structure as related to position of the leaf upon the shoot and to type of growth.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 145-8, bibl. 3.

Measurements made across leaf sections of several apple varieties indicate that leaf structure varies with the position of the leaf on the shoot. Leaf thickness decreases from the base to the median portion of the shoot and then increases to the apex. The relative density of the leaf as indicated by the proportion of intercellular space increases progressively from the base to the apex. Stomatal frequency likewise increases, but stomatal size decreases, though not in proportion to stomatal frequency, from the base to the apex, so that apical leaves have a larger amount of stomatal pore area per given leaf than have basal leaves. Differences in stomatal frequency per given leaf area were found between leaves from different apple varieties. Structural differences were also observed between comparable leaves from shoots and spurs. It is concluded that, although there are several factors, and in particular that of water supply, which may govern observed differences in photosynthetic rates of different leaves on a shoot, it is also possible that these differences may be associated to some extent with differences in leaf structure.

680. LOTT, R. V., AND ASHLEY, T. E. 634.25 : 581.145.2
Some varietal differences in fruit development in peaches.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 258-64, bibl. 3.

Physical and chemical differences in the development of fruits of Mayflower, Early Rose, Carman and Elberta were studied at the Mississippi Experiment Station during 1935. Data obtained with the variety Hiley in 1933 are also included.

681. BLAKE, M. A. 634.25-2.111
Types of varietal hardiness in the peach.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 240-4, bibl. 4.

The terms hardy and hardiness are used synonymously in this paper to mean the ability of a tree or parts of a tree to endure in an unfavourable environment, and are not restricted to resistance to low temperatures. Altogether 19 types of hardiness are recognized, and under each the varieties observed to be particularly resistant or susceptible in New Jersey are noted. The observations were made during a period of over 20 years.

682. DORSEY, M. J. 634.25 : 581.145.2
Nodal development of the peach shoot as related to fruit bud formation.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 245-57, bibl. 15.

A study was made of nodal development in peach shoots grown under different conditions in order to evaluate more accurately, or interpret, these growth variables in terms of potential production. The observations made are described and discussed in detail, and a classification to include all the nodal growth structures is proposed. 27 photographs add to the value of the article.

Manuring, Cultural practice.

683. McCUE, C. A. 631.84 : 634.25
Relative effect upon peach production of nitrogen derived from certain fertilizer sources.

Trans. Peninsula hort. Soc. for 1935, 1936, 25 : 5 : 10-2.

An Elberta peach orchard planted at the University of Delaware in 1921 was used for the comparison of different forms of nitrogenous fertilizer. Treatments were continued up to 1932, and average yield records for 10 years are tabulated. The results indicate that the source of nitrogen for peaches need not be confined to nitrate of soda. Yields from two check plots receiving no nitrogen were far below those of any fertilized plot. In general better yields were obtained from the use of the inorganic fertilizers, nitrate of soda and sulphate of ammonia either combined in equal parts or alone, than from organic manures, with the exception of dried blood, which, however, is too expensive and difficult to obtain. When yields of the first 5 years were considered separately, tankage gave the best results and is recommended for young orchards, while during the same period a cow pea cover was found to supply almost all the nitrogen requirements of the trees. With regard to organic nitrogen carriers the author concludes that the price per unit of nitrogen, from year to year, would probably be the best guide in deciding which to use.

684. SCHRADER, A. L. 631.84 : 634.11 + 634.25
Comparisons of various nitrogen fertilizers especially in relation to fall applications versus spring applications.

Trans. Peninsula hort. Soc. for 1935, 1936, 25 : 5 : 81-5, bibl. 11.

In reviewing the results of a number of fertilizer experiments made on apples and peaches in Maryland the author stresses the different responses shown to various nitrogen carriers by trees which are actually suffering from nitrogen deficiency and those which merely require nitrogen for maintenance purposes. Trees in the latter group have given quite similar responses to sodium nitrate, ammonium sulphate, calcium nitrate, calnitro, calurea and urea. In the case of nitrogen deficient trees, on the other hand, sodium nitrate has, in some five different trials, given superior results to sulphate of ammonia during the first 1-3 years, or, in other words, until the trees were no longer definitely deficient in nitrogen. Similarly, in one of these trials urea, leunaspeter and calcium nitrate proved in general inferior to ammonium sulphate. As regards the time of application, autumn applications and applications divided over the autumn and spring (so-called "split applications") have on the whole given superior results to spring applications. One of the advantages of autumn applications is that they do not delay the maturing of the tree and fruit as may the use of spring applications, especially when the form of nitrogen employed is slow-acting. It is suggested, however, that if the amounts of fertilizer used exceed 4-5 lb. per bearing tree the applications might well be divided between the autumn and spring to avoid excessive leaching, which might occur if large amounts were applied at one time, especially on sandy soils. Of the individual fertilizers, sodium nitrate is recommended for nitrogen deficient trees, but otherwise ammonium sulphate used in the autumn will give equally good results. The only disadvantage of calcium nitrate is that it is unpleasant to handle. Cyanamide, unless in very small amounts, should be used only in the autumn, because when used in the spring in both Maryland and Michigan it has caused pronounced injury to apple and peach trees. Potassium nitrate has given good results in New York and Virginia, and should be of particular value where potash as well as nitrogen is required.

685. MARSEILLE, O. 634.1/8 : 551.56
 Ueber die Abhängigkeit der Obsterträge von Temperatur und Niederschlag.
(The dependence of fruit crops on temperature and rainfall.)

Gartenbauwiss., 1936, 10 : 289-353, bibl. 20.

In this very adequately tabulated article the author gives an account of the observations made over a period of 10 years or more on a number of individual trees of some 5 pear and 7 apple

varieties at Hohenheim and of 7 pear and 8 apple varieties at Berlin Dahlem. Attempts are made to correlate size of crop with the climatic factors of temperature and rainfall. Despite the differences noted at the two places certain general conclusions are reached. Although the date of effectiveness of different temperatures and rainfall varies with different fruit species and varieties, it was clearly shown that summer weather conditions are much more important than winter and that the period from April to August is a particularly critical one. Under the conditions which obtained the effect of absence of winter rainfall and in fact of rainfall up till April inclusive was negligible. From May onwards rainfall is all important, the more so the less the water holding capacity of the soil. The amount of rain in July and August is a very important factor, dry conditions at that time favouring a good crop the following year. The temperature factor is closely connected with that of rainfall and in spring, especially April, it is the deciding one, its actual effect at any time varying with altitude. Size of crop was greatly influenced by temperature and rainfall at critical periods, any one crop being affected by their proportions both in the year of cropping and in the previous year. Certain varieties were much more susceptible to the influence of these factors than others, some apples in particular showing indifference to frost, and pears in general being very dependent on spring climatic conditions. The problem of irrigation is shown to be very important and it is considered that before recommending artificial irrigation in May or June, the time when water is most urgently wanted in German orchards, experiments must determine whether irrigation can effectively replace natural rainfall, and, if so, whether such a practice is economical. Exact records must be obtained of blossoming and leaf fall dates and of the weather conditions of particular varieties in different places, and any correlations found must be noted. This would, incidentally, greatly help towards a solution of the late frost problem. Finally, breeding appears to afford a road to the attainment of varieties which can be relied on to crop and to show comparative indifference to climatic factors.

686. McMUNN, R. L.

551.57.018 : 634.11

The distribution of rain under an apple tree.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 95-8.

The distribution of rain under and around a large Jonathan apple tree was measured in 20 tin cans from the end of April to mid-December. The cans were placed at 4 ft. intervals, 10 lying NE to SW and 10 SE to NW. The smallest amount of water was caught in the cans placed 4 ft. from the trunk, the average being less than half that caught in cans placed in the open. The foliage shed a large quantity of water at the periphery of the tree, and even after the leaves had fallen the distribution remained unequal. Considerable variations in distribution were found to be associated with the direction of the prevailing winds.

687. BOYNTON, D., AND BATJER, L. P.

634.11-1.87-1.432

The influence of mulching apple trees on the moisture-holding capacity of the topsoil.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 92-4, bibl. 3.

When apple trees growing in a silty clay loam soil were mulched with stable manure at a rate of $\frac{1}{2}$ ton per tree for 5 years, and then at a rate of 1 ton per tree for the next 5 years, the moisture equivalent of the soil showed a considerable increase. Mulching for 4 years with leguminous hay also resulted in a significant increase, but no increase was produced by 2 years' mulching with straw.

688. LILLELAND, O.

634.1/2-1.85

Phosphate response with closely planted one-year-old fruit trees.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 114-9, bibl. 2.

The trials outlined here were carried out in California in a soil very deficient in phosphorus and with an extremely high fixing power for phosphate. 20 lb. of treble superphosphate placed in the planting holes and mixed with some soil produced marked responses in closely spaced nursery apple, peach, prune and apricot trees. The leaves on the treated trees were larger, darker green and with a glossy surface and different texture to leaves on untreated trees. Shoot

growth, weight of root system and trunk cross-sections all showed distinct increases. The top: root ratio of apples, but not of the other species, was significantly increased by phosphate. Leaf analyses are tabulated to show that the phosphate content in the leaves of the treated trees was three times that of the checks in the early part of the season and twice at the end of the season. Smaller responses were obtained in subsequent trials where smaller amounts of phosphate were applied, and in a permanent planting, in which the trees each received 50 lb. treble superphosphate, leaf analyses revealed no increase in phosphorus content. It is concluded, therefore, that the phosphate has been fixed in the soil and that additional amounts should be applied.

689. WIGGANS, C. C.

634.1/7-1.432

The effect of orchard plants on subsoil moisture.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 103-7, bibl. 3.

Data are presented which indicate that where rainfall is deficient, as in Nebraska, orchard trees deplete the subsoil of moisture to very considerable depths. For instance, in an orchard of 17-year-old trees, spaced 30 × 33 feet and interplanted with filler trees to give 86 trees per acre, it was found that the trees in the filler section had already utilized 85% of all available soil water within the zone from 5 to 30 feet in depth. The depletion, at any rate in early years, is apparently greatest directly beneath the tree and decreases proportionately as the distance from the tree increases. Variety appears to play a considerable part in the extent of the depletion; thus, whereas under some 19-year-old Grimes trees nearly 80% of the available subsoil water had already been used, under comparable Blacktwig trees in the same orchard only about 35% had been used. A case is mentioned in which an old orchard was grubbed and replanted before the depleted reserve of subsoil water had been fully replaced, and the author considers this to be a probable explanation of the comparative failure of many replanted orchards. In a vineyard, part mulched continuously for 10 years and part clean cultivated, it was found that whereas in the latter section about 50% of the available water between 5 and 30 feet had been used by the plants, the moisture content of the mulched rows was as high or higher than that in an adjacent field which had produced only surface-rooted farm crops. Investigations in a white pine grove indicated that, if the trees are removed and further water loss prevented as far as possible, a loess soil, especially in the upper layers, can regain its lost moisture fairly rapidly.

690. SMITH, G. E.

634.11-1.84

Studies of fall and spring applications of nitrogen fertilizers to apple trees.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 120-3, bibl. 5.

A study was started in 1934 of the transformations in the soil, penetration, rates of absorption and physiological effects of calcium cyanamide, ammonium sulphate and sodium nitrate on apple trees, when these fertilizers were applied early and late in both autumn and spring. The apples were vigorous 15-year-old Golden Delicious and Gano trees growing in loess soil under blue-grass sod culture. Soil samples were taken at different depths at 2 to 4 week intervals and analysed for nitrate and ammonia, and analyses for total nitrogen were also made of entire blue-grass plants and of fine tree roots from the top 8 inches. Preliminary results indicate that the ammonia form of nitrogen may be absorbed as readily as the nitrate in this soil, and that under moist conditions, where rain falls shortly after an application, calcium cyanamide is almost as rapidly available to the trees as is ammonium sulphate. Under drier conditions, however, cyanamide fails to penetrate into the soil sufficiently quickly, and an appreciable quantity of it is transformed into insoluble dicyandiamide. The results also indicate that tree roots are active during the winter, and that these three fertilizers can be effectively applied in the autumn.

691. FISHER, D. V.

634.21-1.542.14

Apricot thinning investigations.

Sci. Agric., 1936, 16 : 644-51.

The experiments were carried out at the Summerland Experiment Station, B.C. Apricots were thinned to 2 and to 4 inches apart, and to more than 10 leaves per fruit. In all cases increase

in size was extremely slight or wanting. Fruit, thinned or unthinned, was largest on the upper exposed branches. With unthinned trees harvest was prolonged 12 days beyond completion of picking thinned trees owing to more uneven maturing. Some delay in maturity was caused by very late thinning. Providing ordinary good cultivation is applied, high grade apricots can be produced without thinning, a process which merely reduces yield without increase in size or quality and is, therefore, wasteful and ineffective.

692. CHANDLER, R. F. 634.11 : 581.192 : 631.83
Absorption, distribution, and seasonal movement of potassium in young apple trees and the effect of potassium fertilizer on potassium and nitrogen content and growth of trees.

J. agric. Res., 1936, 53 : 19-42, bibl. 19.

The seasonal chemical changes associated with potassium (K) in various fractions of 2-year-old Stayman Winesap apple trees were determined at College Park, Maryland. All the trees received applications of nitrogen and phosphates, half the number received no potash, and the other half received a heavy application of 1 lb. sulphate of potash per tree. These materials were applied on 1 April, 1933, and the chemical determinations were made from samples collected at 12 intervals between 8 April, 1933, and 8 January, 1934, inclusive. The absorption of K was found to be proportional to dry weight accumulation in the trees receiving no potash. Starting slowly, it continued rather rapidly during the growing season and then slowed down with the approach of growth cessation in the autumn. In the potash fertilized trees, K was absorbed at a greater proportionate rate than dry weight was accumulated. The new growth showed, in general, a relative increase of K throughout the season, while one- and two-year-old tissues showed proportional decreases. The amount of K in the roots apparently decreased markedly during the period of rapid growth, but increased during the latter part of the season. With exception of the leaves after the beginning of abscission, the absolute amount of K generally increased in all portions of the tree throughout the season. On a percentage dry-weight basis, however, the K content of the current season's growth decreased throughout the season, that of the 1-year-old wood increased during May but later decreased, while that of the 2-year-old wood remained constant. Generally the concentration of K decreased from the apex to the base of the tree, while in actual amount present the reverse was true. Old leaves contained much less K than young leaves, which may have been due either to leaching or to migration. There was a rather high correlation between N and K in the trees. The chief apparent differences were that some N was absorbed late in the season, whereas K absorption stopped at leaf fall, and that the N content of the tree was depleted considerably during the summer by movement into the leaves, whereas with K absorption from the soil was able to maintain a uniform concentration in the wood and bark and still maintain the content of the leaves. In the trees receiving a heavy application of potash the concentration of K was increased in all parts of the tree, the greatest increase being in the leaves, the next in the bark, and the lowest in the wood. For reasons not adequately explained the N content of the trees was also increased by potash fertilization. No growth differences attributable to the influence of potash fertilizer were found among the trees, and the results, therefore, indicate without doubt that apple trees can absorb more K than they require for normal healthy growth and cropping.

693. MARSH, R. S. 634.11-1.416.13
Soil nitrate nitrogen determinations following applications of calcium cyanamide and nitrate of soda to the surface of the soil under apple trees during dry and normal seasons.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 142-4, bibl. 5.

Data are presented and discussed briefly which indicate that in certain regions and within certain limits a deficiency of rainfall and higher than normal temperatures in the late summer and early autumn will increase soil nitrate nitrogen levels to an extent which makes it profitable to omit or greatly reduce spring applications of inorganic nitrogenous fertilizers. Secondly, in comparing calcium cyanamide and sodium nitrate it is shown that soil nitrates may be present in greater

amounts during certain periods of the year where the former is used. These results were obtained in Southern Illinois.

694. SHAW, J. K., AND SOUTHWICK, L.

634.11-1.87

Heavy mulching in bearing apple orchards.

Bull. Mass. agric. Exp. Sta. 328, 1936, pp. 15, bibl. 12.

The effect of annual heavy mulching with low-grade hay has been compared with that of cultivation plus a cover crop over a period of 15 years in an orchard consisting of bearing McIntosh and Wealthy apple trees. No additional fertilizer was supplied to the mulched plots, but the cultivated plots received nitrate of soda at a rate of 300 lb. per acre per annum during the last 6 years. Records taken in two summers indicate that surface soil moisture contents and soil temperatures differed little under the two treatments except slightly during dry and warm periods respectively. By the end of three years soil nitrates had become much higher under the mulch, rising to a maximum of 400 p.p.m., and continuing high during autumn and early winter. This did not, however, produce excessive tree growth, although both growth and yield were greater than under cultivation. Fruit from the mulched trees matured a little later, but the proportion of fruits dropping prematurely, though varying widely in different seasons, was also greater than on the cultivated trees. There were no marked differences in colour or quality. McIntosh responded with increased growth and cropping to the application of nitrate of soda to the cultivated plots, but Wealthy responded only very slightly. The results suggest that heavy mulching is a satisfactory, though rather costly, system of orchard management. Possible objections include danger of injury from mice and fire. Mulching would appear to be most desirable where a cheap source of material is available, on comparatively steep slopes, on rough, stony land, on loose, gravelly soils liable to suffer from water shortage, for varieties apt to drop a high proportion of fruit near harvest time, and where root injury from cold is feared. The majority of trees in the trial here reported were growing on standard seedling stocks. Some interplanted Wealthy trees were, however, growing on Malling No. V, and, on an assumed acre basis, these trees cropped more heavily than those on seedling roots, and showed a smaller percentage premature fruit drop, although the fruit was slightly smaller.

695. COLLISON, R. C., AND ANDERSON, L. C.

634.11-1.8

Fertilizer experiments in the Morganthau orchard: six years' results with nineteen treatments.

Bull. N.Y. St. agric. Exp. Sta. 661, 1936, pp. 32, bibl. in text.

The effects of 19 fertilizer treatments applied over a period of 6 years to McIntosh trees, which were 14 years old at the outset of the trial, are reported in this paper. The orchard was situated in the Hudson Valley, and the soil, with a pH of 5.5 to 6.0, was of light texture, low in organic matter, and was regarded as of low productivity. All fertilizer treatments contained nitrogen. They consisted of 6 partial or complete fertilizer combinations including nitrogen, phosphates, potash and lime in different forms, 6 nitrogen carriers applied alone in a heavy and a medium dressing in each case, and a control plot receiving no fertilizer. A randomized block layout giving nine replications was adopted, and statistical interpretations of the results were made by the analysis of variance and covariance as formulated by Fisher and others. All treatments gave significant increases in yields and gains in trunk girth over the control, but neither phosphates nor potash in the combined fertilizers gave any significant increases over nitrogen applied alone. Lime, too, had no apparent effect. Yield increases associated with the heavier applications of nitrogen as compared with the medium dressings were in no case significant, but significant gains in trunk girth resulted from the heavier applications in every case. All the nitrogen carriers gave more or less equivalent results, but it is pointed out that this is not to be expected under other soil conditions. Whether the continuous use of nitrogen alone over a considerable period of years will upset the nutrient balance is uncertain, but the authors discuss various factors which contribute toward preventing, or at any rate postponing for a long time, the advent of such troubles to a serious extent. Under the great majority of soil conditions in

the eastern U.S. it would seem, at present, inadvisable to recommend the application of phosphorus or potassium to apple orchards. In a section devoted to statistical analyses it is noted that adjusting yields for tree size had very little effect on the results, if anything increasing the general significance of fertilizer effects and reducing considerably the standard error. Size of tree proved a less important factor in fertilizer responses than did soil.

696. OVERHOLSER, E. L., AND CLAYPOOL, L. L. 634.13-1.8

The response of d'Anjou pears to fertilizers in central Washington.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 299-303, bibl. 3.

The effects of N alone and in various combinations with P and K and of P + K without N were tested over a five year period on vigorous d'Anjou pear trees, propagated on *Pyrus serotina* rootstock, and growing in a fine sandy loam soil. The results indicate N to be the first limiting soil fertility factor. Where it is deficient, nitrogenous fertilizers tend to increase vegetative vigour and to improve slightly the size and yield of fruit. The use of either P or K together without N, or in combination with N, did not appear to have any directly beneficial effects. Cork spot, a physiological disorder associated with the use of *P. serotina* rootstocks, was not influenced significantly by any of the fertilizers.

697. RAWL, E. H. 634.25-1.84

Peach tree abnormalities developing from applications of nitrogen fertilizers alone. (Preliminary report.)

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 293-8.

Abnormal growth and fruiting conditions in an Elberta peach orchard in South Carolina have been associated with the almost exclusive use of sulphate of ammonia annually over a 10-year-period. In early stages the leaves changed to a light yellowish-green colour, then to very pale yellow, and later showed burning or scorching of the tips, finally becoming curled and bronzed. The majority of the buds were shed at blossom time, and the remaining small crops consisted of undersized fruits. The continuous use of sulphate of ammonia and of sulphur in sprays was found to have increased the soil acidity considerably. Fertilizer experiments were started in the orchard in October, 1934, and in plots receiving nitrogen, phosphorus, potassium, and either dolomitic limestone or basic slag both trees and a rye cover crop made normal and satisfactory growth the following year. In a plot receiving nitrogen alone the abnormal condition of the trees was again manifested and the major portion of the cover crop died.

698. BATJER, L. P. 634.11-1.542.3

Crotch angles as affected by the method of training young apple trees.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 36-8, bibl. 4.

It is generally held that most scaffold limbs of apple trees forming an angle of less than 40° are liable to be weak. With this in mind three methods of training 1-year-old trees to obtain modified leaders were compared for the varieties Rome Beauty, Delicious and Stayman :—(1) *Heading at 30 inches*, suitable scaffold limbs being selected after the first season's growth and all other growths removed :—(2) *Single disbudding*, all buds being removed at the outset of the first season's growth except 3-4 buds so situated as to form the primary scaffold system :—(3) *Group disbudding*, in which 3-4 buds were left to develop during the first season at each height where one scaffold branch was ultimately required, all but the most desirable shoot being removed before the second season started. With all three varieties heading at 30 inches produced the largest crotch angles, and single disbudding the smallest, while group disbudding was intermediate in effect. There were no consistent differences in tree size as measured by trunk circumference after either the first or the fifth growing season. The conclusion is tendered that the disbudding methods, which produce an almost ideal distribution and spacing of branches, would seem to be suitable for spreading varieties such as Stayman, but that for upright growing varieties a sufficient number of shoots should be allowed to develop during the first season to secure satisfactory crotch angles.

Harvesting, Marketing.

699. MINISTRY OF AGRICULTURE. 634.1/8-1.56
Fresh fruit. Grading and marking.
Market. Leaflet. Minist. Agric. Lond., 59, 1936, pp. 82.

The revised regulations of September, 1935, for National Mark and other standard grades are defined and illustrated for each fruit. The National Mark Scheme is fully explained. Much other information on various matters connected with marketing of high grade fruit is contained in the 7 appendices. The issue of January, 1935 (*H.A.*, 5 : 2 : 309) is to some extent superseded in that certain grading standards have since been revised. The appellation "leaflet" applied to a comprehensive work of 82 pages is modestly misplaced, particularly in a publication whose main purpose is to insist on the importance of a correct designation of grades.

700. HAMPSON, C. C. 634.11 : 338
Apple prices received by Washington growers.
Bull. Wash. St. agric. Exp. Sta., 326, 1936, pp. 59, bibl. 2.

An analysis of costs of shipping point marketing services for apples in Washington State for the 12-year period, from 1922 to 1933 inclusive, was published in *Bulletin 312* *. The present bulletin furnishes weighted average apple prices received by growers over the same 12-year period, and, as in the bulletin devoted to costs, the data referring to the first 6 years have already been published in *Bulletin 242*. The analysis is based on 42% of the total number of boxes shipped from the Wenatchee-Okanogan and Yakima districts of Washington during these years. Prices for the two districts, combined and separately, are tabulated in a comprehensive appendix (pp. 31 to 59) as well as in the text. The weighted average price of all varieties, grades and sizes of packed apples, delivered to the warehouse at shipping points during the 12 years, was \$1.05 per box. The highest average price for an individual year was \$1.66 (1924 and 1927) and the lowest 45 cents (1932). The average for the four years following 1929 has been 51 cents below the average for the eight preceding years. Over the whole period Extra Fancy grade apples fetched an average of 29 cents more per box than Fancy and 49 cents per box more than C grade apples. The average prices per box for apple varieties were:—Delicious \$1.40, Yellow Newtown and Winter Banana \$1.09, Winesap \$1.06, Jonathan 84.2 cents and Rome Beauty 83.6. The differential in favour of Delicious has, however, been decreasing since 1924. In the general decline of prices, Yellow Newtown has been less affected than other varieties, but Winter Banana prices have declined more than the average of other varieties. Price differences between apples of the same variety and similar quality from the two districts under review have been very slight.

SMALL FRUITS, VINES, NUTS.

701. VYATKIN, V. 634.37-2.111
Reactions of the fig tree to low temperatures. [Russian, English summary.]
Soviet Subtropics, No. 1 of 1936 (17), pp. 43-9.

One year shoots of fig while dormant can resist temperatures of -8° to -10° C. Differences in soil moisture content do not affect the resistance of fig trees, or at any rate only temporarily in the autumn. This resistance to cold makes it possible to cultivate the fruit in some parts of Russia.

702. THOMAS, C. C. 634.71-1.535.7
Leaf-bud propagation of several introduced species of *Rubus*.
Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 377-9, bibl. 1.

Leaf-bud cuttings, resembling shield buds used in budding, of *R. armeniaca*, *R. ellipticus*, *R. fraxinifolia*, *R. glaucus*, *R. parvifolia* and *R. leucodermis* showed 90-100% rooting in sharp sand under a glass cover in 10-14 days. Two hybrids, Brainerd and Van Fleet, showed 40-50% rooting in 3-4 weeks. The latter are hybrids between tip-rooting and suckering species. The other types, however, all propagate naturally by tip rooting, and the experimental results supply additional evidence that species and varieties of *Rubus* which multiply themselves in this manner may be propagated by leaf cuttings.

* *H.A.*, 1935, 5 : 4 : 564.

703. SUDDS, R. H. 634.711-1.535 : 581.144.2

The origin of roots in several types of red and black raspberry stem cuttings.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 380-5, bibl. 8.

The types of cuttings studied were leaf-bud cuttings and single-eye hardwood cuttings of black raspberries and softwood tip cuttings of red raspberry suckers. The text is accompanied by photomicrographs of root primordia in transverse sections of the different types of cuttings.

704. WALDO, G. F. 634.7 : 581.145.2

Fruit bud formation in small fruits and its relation to cultural practices.

Proc. annu. Mtg. Ore. St. hort. Soc. for 1935, 50, being 27th annu. Rep., pp. 75-81.

Studies on the differentiation of fruit buds in small fruits made in various parts of the U.S., and particularly in Oregon by the author and other workers, are outlined. The conclusions drawn may be summarized as follows :—*Strawberries*. Fruit buds develop in the autumn and no more are formed in the spring except in the southern states. Since it has been established that large plants develop more fruit buds and bear more fruit than small plants, cultural practices should all be directed towards producing large, strong plants, perhaps the largest, strongest possible, by the end of the growing season. *Red raspberries*. Studies in Oregon have shown that fruit bud differentiation is progressive from the upper part of the cane downwards. In seven varieties examined buds in the upper parts of the canes were found to be fully differentiated by mid-September. In the lower portions of the canes some varieties formed fruit buds during the period November-March, whereas others showed no definite differentiation before early March. As investigations have shown that the strongest fruit buds are borne by the strongest canes, the objective in red raspberry growing should be to obtain the largest possible number of large sized canes. *Black and purple raspberries*. Fruit bud formation tends to start in the outer or terminal parts of the canes, but the tendency is less marked in purple, and still less in black raspberries than in red raspberries. In black raspberries differentiation was found to occur from mid-September onwards in Oregon. Investigations in other states indicate that the largest berries are borne on branches originating on the base and middle portions of the main canes, and that yields from canes and laterals and size of fruit are clearly associated with diameter or size of cane. *Dewberries and blackberries*. Fruit bud differentiation appears to start at some time between mid-September and the end of January depending on variety and locality. Studies in Oregon suggest that in some varieties the middle portions of the canes possess the most advanced buds, but that in others variation is too great to permit of a definite conclusion. More knowledge is required on the relationship between pruning and fruit bud formation. *Gooseberries and currants*. In New York differentiation in the Houghton gooseberry was found to begin on 16 August, while in red currants it was found to occur somewhat earlier than this. *Cranberries and blueberries*. Fruit buds were first observed in the former in mid-August in Massachusetts. No studies have yet been made on blueberries, but from the appearance of the buds it is evident that many fruit buds are formed during the early part of the summer, nearly a year prior to fruiting.

705. SNYDER, J. C. 634.711 : 581.145.2

Flower bud formation in the Latham raspberry.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 417-22, bibl. 4.

A description is given of the pre-differentiation and differentiation development of flower buds in Latham raspberries growing at Ames, Iowa. The first visible evidence of flower initiation was observed in buds collected on 25 April. The text is illustrated by a number of diagrams.

706. WINTER, J. D., AND ALDERMAN, W. H. 664.85.7 + 634.711 + 634.75

Picking, handling and refrigeration of raspberries and strawberries.

Bull. Minn. agric. Exp. Sta., 318, 1936, pp. 39, bibl. 26.

The condition of berries on the markets is determined by (a) firmness, (b) freedom from injury, (c) maturity, (d) weather conditions during ripening, e.g. temperature of the berries after picking.

Chief and Latham, which together form 90% of the raspberry crop of Minnesota, keep equally well in storage, though Chief remains brighter and therefore more marketable after the same storage period. Raspberries picked at the same time but by different pickers showed wide variation in subsequent rate of decay. Injury in the field prior to picking (e.g. by birds or insects) caused more rapid decay of strawberries than injury at time of picking. Raspberries held for 6 days in a refrigerator showed no differences in keeping quality which could be correlated with the time of day at which they were picked, but, if not cooled or cooled only for short periods, early morning or late afternoon pickings kept better than those made in the middle of the day. A well ventilated shed consisting only of a roof and partial protection on the south side was found to cool raspberries more rapidly than an enclosed building with doors and windows open, a cellar or a position on the ground in the shade of a bush. A Hallock-type ventilated crate cooled the fruit more effectively than a non-ventilated crate of the same type and wood veneer pint boxes were more effective in this respect than paper-board pint containers. Directions are given for the construction of a refrigerator to hold 38 24-pint crates and keep raspberries in marketable condition up to seven days and strawberries for longer.

707. MOORE, J. G. 634.711 + 634.715

Growing raspberries and blackberries in Wisconsin.

Circ. Wis. Coll. agric. Ext. Serv., 280, 1936, pp. 16.

An account is given of site, soil, three systems of planting, soil management, manuring, pruning, harvesting, and diseases and pests of raspberries and blackberries in Wisconsin. Satisfactory raspberry varieties include Latham, June, Viking and Columbian. The only blackberry now commonly recommended is Eldorado.

708. STENE, A. E. 634.711-1.8

Fertilizer treatments of red raspberries.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 411-4, bibl. 4.

N, P and K fertilizers were applied to Latham raspberries in various combinations in two experiments made in Rhode Island. Three-year average yields in each case reveal that K is as important, if not more important, than N, and that P has only a slight effect. In view of the fact, however, that P is required by cover crops, it is suggested that under conditions similar to those of the experiments all three elements should be applied to raspberries.

709. POTTER, J. M. S. 634.715-1.534/5

Propagation of blackberries.

J. roy. hort. Soc., 1936, 61 : 437-8.

Methods of propagating blackberries vegetatively other than by tip layering, which limits the number obtainable to the number of new growths, were tried at Wisley with Bedford Giant and John Innes. Serpentine layering in which alternate lengths were notched at every third node, pegged down and covered with soil in October, had produced roots by May only in the two notched, unripe sections immediately behind the apex. The remainder had callused without forming roots. Of 200 ripe wood cuttings consisting of three nodes and taken from base, centre and apex of the shoot in November all but one died. Root cuttings 2 inches long were placed in shallow boxes without soil in February, kept in a temperature of 55°-60° F., shaded with sheets of paper and sprayed with water two or three times a day. After a month all the John Innes had formed buds but only 10 per cent. of Bedford Giant. Thin cuttings produced buds more quickly than thick. All the buds except the strongest were removed, the plants potted in sandy soil and placed in a warm house until root growth had started. After hardening off the plants were ready for transplanting to the open in May. Experiments are continuing to determine the most suitable season for taking root cuttings, and also the possibility of striking soft wood cuttings.

710. BROWN, W. S. 634.7-1.67

Influence of irrigation upon yields, quality and profits of small fruits.

Proc. annu. Mtg. Ore. St. hort. Soc. for 1935, 50, being 27th annu. Rep., pp. 82-6.

Investigations on the irrigation of soft fruits were started in the Willamette Valley, Oregon, in 1926, and results obtained in the first five years were presented in an earlier paper.* During that period prices were satisfactory and irrigation proved to be a means of increasing yields and net profits. During the five year period, 1931-35 inclusive, however, costs of production for blackberries and loganberries were on the average higher than the price received. In such circumstances the maintenance of high yields associated with high production costs frequently resulted in the greatest losses. Thus, as is shown clearly in a table, the irrigating of blackberries resulted in greater losses, despite increased yields, than did leaving the crop unirrigated. A similar result was obtained with loganberries during the latter four years, but in 1931, the last year of fair prices, irrigation produced a substantial increase in net profits. By contrast with these two crops, strawberries showed fairly good profits every year, and the net income from irrigated crops has averaged more than double than that from unirrigated crops. As regards the effect of irrigation on quality, the earlier conclusion that it increases size of the fruit is confirmed. This applies particularly in the latter part of the season, July and August being very dry months and the two preceding months being fairly dry. The appearance, grade and price of small fruits has usually been considerably improved by irrigation. No significant differences between irrigated and unirrigated fruits have been found in acid content, keeping quality, colour, shrinkage and susceptibility to moulds. Unirrigated loganberries and strawberries have had sugar contents 25 to 33% higher than irrigated fruits, but blackberries have shown no significant differences.

711. FLEMING, W. M. 635.611-1.67

Irrigation of cantaloupes.

Sci. Agric., 1936, 16 : 634-43, bibl. 6.

Irrigation of cantaloupes was experimentally conducted over a period of 3 years at the Summerland Experiment Station, B.C. The greatest total yields and the highest grade fruit were obtained with a weekly application of $\frac{1}{2}$ inch. More heavily irrigated plots showed a reduction of yield which chemical analyses of the soil suggest may be due to the leaching of nitrogen from the upper soil areas.

712. JOHNSTON, S. 634.73-1.535

Propagating low- and highbush blueberry plants by means of small side shoots.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 372-5.

Softwood cuttings of lowbush blueberry plants, consisting of small side shoots 2 to 4 inches long, rooted much more rapidly than normal hardwood cuttings. Cuttings with heels were slightly superior to straight cuttings. In similar trials with two highbush varieties straight side shoot cuttings gave almost as satisfactory rooting as long standard softwood cuttings and proved better than cuttings with heels or with a mallet shaped piece of main stem at the base. Of the rooting media tested Sorbex gave somewhat better results than German peat in both trials. The use of side shoot cuttings would be of value where rapid multiplication is of primary importance, but it is not recommended that they should replace the standard type of cutting for ordinary purposes.

713. LONG, J. H. 631.8 : 634.75 + 635.64

Seasonal changes in nitrogen and carbohydrate content of the strawberry plant.

DARROW, G. M., AND WALDO, G. F.

The moisture content of strawberries as influenced by growing conditions.

* Schuster, C. E., and others. Preliminary report on the effect of irrigation on major berry crops in the Willamette Valley. *Bull. Ore. agric. Exp. Sta.*, 277, 1931, pp. 51.

GREVE, E. W.

Some effects of nitrogen fertilizer and irrigation on the growth and blossoming of the Howard 17 strawberry.

VAN METER, R. A.

Effects of late summer and fall applications of nitrogen on fruit production in the strawberry.

HAUT, I. C., WEBSTER, J. E., AND COCHRAN, G. W.

The influence of commercial fertilizers upon the firmness and chemical composition of strawberries and tomatoes.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 386-8, bibl. 11, 393-6, bibl. 5, 397-400, bibl. 1, 401-4, bibl. 2, and 405-10, bibl. 3.

[1] Determinations were made of fresh and dry weights, total sugars, starch, hemicellulose and total nitrogen in a study of the seasonal changes in nitrogen and carbohydrates throughout the year. The plant material consisted of primary daughter plants of the variety Aroma. In general, the results indicate that the strawberry plant behaves like a biennial in that it stores large quantities of nitrogen in the summer and autumn, making these products available in the spring and utilizing them in the production of fruits and new growths. This may help to explain why old plants are not so productive as new ones.

[2] Tests carried out over three years with several strawberry varieties indicate that, despite wide seasonal variations, the dry weight of the ripe fruit normally increases with successive pickings. In general, larger fruits have a lower dry weight than smaller ones. Heavy nitrogenous fertilizing under conditions of ample, but not excessive, soil moisture results in berries with lower dry weights, and this also appears to be due to the greater size of the fruits from the fertilized plots.

[3] Nitrogen fertilizer, applied during the year prior to fruiting was found to have a depressing effect on the number of plants formed, the number of leaves per plant, the length of runners between plants and the number of blossoms per plant. Irrigation had little if any effect, but this may have been due to abnormally heavy rainfall occurring in the latter part of the growing season about the time of fruit bud initiation. Both the tops and roots of plants receiving nitrogen had a lower total carbohydrate : total nitrogen ratio than did those of plants receiving no fertilizer. The soil used in these experiments was a sandy loam in a fairly high state of fertility.

[4] Seven experiments on the influence of nitrogen applied to strawberries in the year preceding harvest are summarized. Phosphates and potash were supplied in every case in relative abundance. The general conclusion drawn is that the results give little indication that nitrogen applications, made in the summer or autumn, were in any way either beneficial or injurious under the not unusual conditions prevailing in the experiments.

[5] Analyses of the fruits of Aroma strawberries made in four successive crops failed to show any appreciable differences in composition of the fruits from plots receiving different N, P, K fertilizer treatments. Nitrogen plots produced berries with a higher moisture content and with a tendency towards slightly lower total sugars. Analyses for nitrogen, made in one year only, indicate an increase from the higher nitrogen treatments. There were also no significant differences in the firmness of the fruits associated with different treatments. With Pritchard tomatoes no significant correlation was found between fertilizer treatment and composition of the fruit.

714. GREVE, E. W.

634.75-1.8

The present status of the fertilizer problem and recent developments in strawberry culture.

Trans. Peninsula hort. Soc. for 1935, 1936, 25 : 5 : 23-30, bibl. 6.

Experimental results obtained in various parts of the U.S. are summarized with particular reference to the fertilizing of strawberries. The time of fruit bud formation appears to be governed by length of day. In Maryland and Iowa it has been found to occur in September and October, but in the warmer south the combination of day length and temperature becomes

suitable for the further formation of fruit buds in the spring. In Maryland and Delaware, however, any fertilizer treatment to affect the number of fruit buds formed must be applied during or before the autumn. The author reviews the results of a number of fertilizer trials carried out in different parts of the U.S. The responses, particularly to nitrogen, have been very variable, and it is suggested that growers should experiment for themselves on small sections of their farms. An account is then given of a trial made in Maryland to determine the effect of nitrogen and irrigation on the growth of strawberry plants. [The results are noted above in the third paper included in abstract 713. ED.] The effect of age on the plants has also been studied. Data obtained in October showed clearly that there was a consistent and gradual decrease in the number of leaves from mother plants down to the youngest runners, and similarly that the number of blossoms produced by a runner plant increased with its age. In spacing experiments made by G. M. Darrow* in North Carolina with the variety Blakemore the largest yield, combined with a high percentage of No. 1 grade fruits, was obtained from plants spaced 9" apart in rows 24" wide. 12" spacing in double rows resulted in larger berries but a smaller yield. Matted row systems in rows 12" and 30" wide gave the smallest berries and the smallest yields. Some method of cultivation to provide proper spacing is thus clearly preferable to allowing plants of this variety to form a matted row. A paragraph is devoted to suggested methods for the removal of runner plants.

715. SPROAT, B. B., AND OTHERS. 634.75 : 581.144.1 : 631.55
Relation of leaf area to berry production in the strawberry.
Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 389-92, bibl. 1.

Experiments made in Maryland and North Carolina with 8 varieties of strawberries indicate a definite relationship between leaf area in the autumn and crop size the following summer. Under conditions existing in these districts the number of fruit buds is normally entirely determined in the autumn, and the extent of fruit-bud formation is apparently governed by leaf area at this time. The practical application is to use any means available, such as cultivation or irrigation, to obtain the largest possible number of leaves per plant.

716. SNYDER, E., AND HARMON, F. N. 634.851 : 575.252
Three mutations of *Vitis vinifera*.
 OLMO, H. P.
Bud mutation in the *Vinifera* grape. II. *Sultanina gigas*.
Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 435-6, bibl. 2, and 437-9, bibl. 4.

[1] A limited study was made of the occurrence of grape mutations during 1934 and 1935. The three described briefly here are a large-berry *Sultanina*, a small-berry *Sultanina* and a seeded-berry *Panariti*.† The last two should be eliminated when planting new vineyards. The first may have some value for breeding work and for local use.

[2] A description is given of *Sultanina gigas*, a mutation characterized by an enlargement of all the cells of the plant [and apparently resembling, if not identical with, the large-berry *Sultanina* mentioned in the first paper. ED.]. The large seedless berries would probably be accepted as table grapes by the consumer, but the mutation has the serious defects of inability to bear well-filled clusters consistently and of brittleness of the cluster stems and pedicels. *Sultanina gigas* is an autotetraploid, arising by somatic mutation, and possesses a total of 76 chromosomes in place of the total diploid number of 38. The origin of such autotetraploid forms is held to be based on the failure of a cell division after chromosome division in the normal diploid form. The *gigas* mutation described was from Thompson's Seedless, but similar forms of other varieties have been observed elsewhere.

* The culture and handling of the Blakemore strawberry. *Bull. N.C. Dep. Agric.*, November, 1934.

† A seeded mutation of the *Panariti* grape. *J. Hered.*, 1936, 27 : 77-8, *H.A.*, 1936, 6 : 2 : 286.

717. WOODRUFF, J. G. 634.848-1.534

Developments in growing Muscadine grapes in the South.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 447-9, bibl. 1.

Attempts to bud or graft or to raise from cuttings the Scuppernong and other varieties of Muscadine grapes, *Vitis rotundifolia*, proved unsuccessful, but it was found that new plants could be easily and economically obtained from old vines by layering. Injury to exposed canes due to the sun can be almost entirely eliminated by layering mature vines only in December, in which case rooted layers should be dug the following December and grown in the nursery for 1 year before setting in the field as 2-year-old plants.

718. ARMSTRONG, W. D. 634.848 : 581.162.3

New varieties and pollination of Muscadine grapes.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 450-2, bibl. 5.

Eleven new varieties of Muscadine, *Vitis rotundifolia*, grapes are mentioned as being retained for further testing. In an acre of female vines of the self-sterile Hunt variety, one of these new types, 6 male vines were planted in a diagonal line, one to every second row. Records covering several years have shown that by far the largest proportion of high yielding vines were found in the neighbourhood of the male vines. Where female vines were situated at about 50 feet or further from a male vine yields dropped sharply. The conclusion is reached that, other factors being considered, the more uniformly the male vines are distributed over the area, the more fruitful the plantation as a whole will be. To assist this, the number of male vines rather than their size should be increased. A study was also made during the 1935 season of the insects frequenting the blooms, and the opinion is expressed that in Georgia, where the trials were made, small black bees of two species of *Halictus* are mainly responsible for pollen dissemination.

719. DURUZ, W. P., AND PENTZER, D. J. 634.8

New and standard grape varieties for Western Oregon.

Proc. annu. Mtg. Ore. St. hort. Soc. for 1935, 50, being 27th annu. Rep., pp. 86-90.

Many standard and new varieties of grapes were planted for trial at Corvallis, Oregon, in 1933 and 1934. The new types were mostly raised by the New York Experiment Station. 47 varieties fruited in 1935 in sufficient quantity to provide samples, and in the present paper brief descriptive notes are given of 13 of the more promising types, 5 being white, 4 blue, and 4 red.

720. WINKLER, A. J., AND WILLIAMS, W. O. 634.8 : 581.14

Effect of seed development on the growth of grapes.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 430-4, bibl. 12.

The growth of fruits in Hunisa, Ribier and Carignane grapes, all seeded varieties of *Vitis vinifera*, exhibited distinct periodicity. Initial growth was rapid, followed by a period of depressed growth and finally by a stage of rapid growth to maturity. Fruits of Sultanina, a seedless variety, on the other hand showed lack of definite periodicity. Data from a study on the Carignane variety of the growth of the plant, the carbohydrate content of the basal section of the canes, and the effect of defoliation at the beginning and end of the second period, appear to show definitely that competition for carbohydrate materials, either between fruit and vine, or between seed and pericarp, is not responsible for periodicity in the growth of the fruit. Nutritional competition between seeds developed within the same berry has also been shown to be very slight. The lack of periodicity in the seedless Sultanina variety and its presence in the seeded types does, however, suggest that seeds may be the causal factor of periodicity.

721. GLADWIN, F. E. 634.8-1.8

A twenty-five-year test of commercial fertilizers for grapes.

Bull. N.Y. St. agric. Exp. Sta., 671, 1936, pp. 24.

Nitrate of soda 250 lb. per acre, superphosphate 300 lb., muriate or sulphate of potash 200 lb. have been applied annually for 25 years in various combinations to plots of vines on gravelly loam soil rich in potassium but low in nitrogen and phosphorus in the Lake Erie grape belt.

Nitrogen increased yield, quality and cane and leaf growth. Potash in combination with the other two increased yield of fruit and wood. Phosphoric acid improved cover crops but not the vines. 2,000 lb. hydrated lime per acre every 3rd year on the complete fertilizer plot depressed yield of fruit and wood. Nitrogen and potash in whatever combination always proved profitable. None of the treatments influenced fruit maturity or winter injury or the sugar content of the fruit in any way, or reduced immature fruit drop which was sometimes serious. A cover crop was used on all plots, the most suitable proving to be rye.

722. JARDINE, F. L. 634.8-1.542
Pruning of grape vines.
Qd. agric. J., 1936, 46: 261-4.

Instructions are given for pruning vines on the unilateral cordon system, i.e. a permanent arm with spurs.

723. SCHRADER, T. 634.8-1.8
 Die Humusdüngung im deutschen Weinbau. (**The provision of humus in German vineyards.**)
Forschungsdienst, 1936, 1: 831-5, bibl. 36.

German vineyards are situated generally on hilly slopes, where there is no great depth of soil and where the stone content of the soil is at least 60% or even rises to 80%, hence the need for the addition of humus, especially to conserve water, is very great. It is shown how experiments immediately after the war made in the hope of replacing organic by purely inorganic manuring were unsuccessful. The many proprietary humus-containing manures now on the market are found on the whole to be too expensive for the commercial grower to use economically. The waste products from wool, lace and other factories are generally only available in too small quantities to solve the problem and liquid refuse of different kinds cannot well be transported. Composting of peat, straw, vine prunings, grass mowings, pressed grape skins, etc. by the introduction of various chemicals on the Adco principle seems to offer a good chance of success. The possibilities of green manuring also are worth exploring, but it is felt that, before any definite recommendations can be made, experiments are essential to determine not only the effect of such compost manures on the action of any inorganic fertilizers also used and the reciprocal effect, but also the effects of all such treatments both on the growth of the vine and on the quality of the grapes or wine produced therefrom. Data on these points are still lacking.

724. STENE, A. E. 634.8-1.8
Fertilizer treatments of grapes.
Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33: 453-5, bibl. 2.

The effects of 5 years' fertilizing of 3 grape varieties with complete fertilizer and with the same amount of fertilizer minus N, P or K on 4 years' cropping is reported. Although the soil used was not considered particularly deficient in K, the results indicate that K is required by the plants at least as much as N, and that inadequacy of it greatly reduces yields. The response to omission of N was relatively small, and to omission of P. negligible. Very similar responses obtained with raspberries on a different type of soil are recalled.

725. CRANE, H. L., AND DODGE, F. N. 634.521-1.542 + 631.841.1
Influence of pruning and applications of ammonium sulphate on the growth, pistillate bloom and set of nuts on pecan trees.
Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33: 42-5, bibl. 2.

The effects of three treatments on 10-year-old Schley pecan trees were compared in replicated plots on light Coastal Plain soil. The treatments, which were started in 1931, were:—(1) pruning plus annual fertilization with 15 lb. sulphate of ammonia, (2) pruning alone, and (3) no pruning or fertilizer. Pruning consisted mainly of thinning out weak shoots so as to open up the centres of the trees in 1931 and to keep them open subsequently. The results up to five years indicate that terminal shoot growth and the formation of pistillate bloom were stimulated by fertilizers,

by pruning or by both together. These treatments increased the number of long shoots, which are naturally more fertile than short shoots, and thus increased the percentage of shoots forming pistillate clusters. In addition, manuring with sulphate of ammonia increased significantly the percentage of pistillate clusters setting nuts and the number of nuts set in each cluster.

726. PROEBSTING, E. L. 634.55-1.841
Field and laboratory studies on the behaviour of NH_4 fertilizer with special reference to the almond.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33: 46-50, bibl. 6.

The results of fertilizing 12-year-old Ne Plus Ultra almond trees with ammonium sulphate over a period of 6 years are described. The soil was a gravelly clay overlying clay and was situated in the Sacramento Valley, California, where the average annual rainfall is about 15 inches, practically all falling between October and May. 7 lb. fertilizer per tree was applied in the first year and thereafter 10 lb. per tree. No irrigation water was applied during the first 4 years, but for the last two irrigation was used to supplement the rainfall, which became deficient towards the end of each growing season. Throughout the 6 years the fertilized trees made more growth, had a larger leaf area, held their leaves longer, resisted red spider attacks better and produced more and larger almonds than did the check trees. With irrigation the response to sulphate of ammonia was increased. Laboratory and field tests indicated that there was almost complete fixation of NH_4 in the upper 4 inches of soil, and that there was no subsequent downward movement of this material. By the end of two weeks there had been sufficient nitrification to permit appreciable quantities of nitrate to be carried by irrigation water to a depth of 2 feet, that is, well into the root zone.

PLANT PROTECTION OF DECIDUOUS FRUITS.*

727. HOAGLAND, D. R., AND OTHERS. 634.1/2-2.19
Little-leaf or rosette of fruit trees. V. Effect of zinc on the growth of plants of various types in controlled soil and water culture experiments.
Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33: 131-41, bibl. 3.

Symptoms of disease resembling those of little-leaf developed on apricot, tobacco, squash, mustard, tomato, sunflower and cotton plants grown in subsoil taken from a little-leaf peach orchard, and in water culture when zinc was not added to the nutrient solution. Corn plants under similar conditions developed symptoms resembling those of "white bud", but alfalfa was apparently very little affected. The addition of ZnSO_4 to the culture medium prevented the appearance of disease in every plant, but the conclusion cannot, however, be immediately drawn that little-leaf disease is solely the result of the unavailability of zinc in the soil for several reasons, which are discussed. An explanation is needed, for example, of the effect of commercial dried sheep manure, which, though containing inappreciable quantities of zinc, also prevented injury to all plants growing in the toxic soil, except corn. In connection with the water culture studies, it is mentioned in passing that insufficiency of boron in the nutrient solution was found to promote a disease in apricot trees. The symptoms were unlike those of little-leaf, but it is clear that in water culture experiments adequate boron should be supplied, 0.5 p.p.m. proving sufficient in these trials.

728. BIRMINGHAM, W. A. 632.19: 634.11
Jonathan spot of apple.
Agric. Gaz. N.S.W., 1936, 47: 512.

Jonathan spot is a blemish in the form of small blackish, slightly depressed spots scattered over the surface of the fruit. The spots differ from bitter pit in being usually only skin deep and in being associated with the lenticels. The trouble is apparently physiological and may appear while the fruit is on the tree or in storage. The disease is not confined to Jonathan apples.

* See also 851, 982.

Should the disease appear the fruit should be marketed at once. To check its occurrence the fruit should be harvested at the correct stage of maturity for its kind and placed in cool store immediately. Delayed storage, especially in high temperatures, increases the disease. Oiled wraps do not control it.

729. DAVIS, L. D., AND TUFTS, W. P.

634.13-2.19

Black-end of pears, III.

DAVIS, L. D., AND MOORE, N. P.

Black-end of pears, IV. pH of Bartlett pear fruits.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33: 304-15, bibl. 6 and 316-22, bibl. 4.

[1] The results of field observations and experiments on black-end of pears are here summarized. The following points of interest emerge:—(1) The disease does not spread from tree to tree in the orchard. (2) Individual trees tend to maintain their relative position with respect to its severity from year to year, and the tendency to produce diseased fruit does not become greater or less as the trees become older. (3) Over four years the number of days elapsing between full bloom and the first appearance of about 50 black-end fruits in 115 trees ranged from 61 to 70. A period of 10 to 20 days after this is characterized by a low rate of appearance of diseased fruits, but thereafter, although with large seasonal variations, a sudden and rapid increase in rate takes place. (4) Heavy pruning, deheading and fruit thinning did not affect the proportion of diseased fruits. (5) Application of lime, KCl, Ammo-Phos B, impure iron sulphate and sulphur to the soil had no effect on the amount of black-end, and iron sulphate, copper sulphate, lead nitrate, lead acetate, oxalic acid, citric acid and tartaric acid put into holes in the trees proved equally ineffective. (6) Earlier observations that the disease was associated with the use of Japanese, *Pyrus serotina*, rootstocks are confirmed. In double working experiments it was found that the fruit produced was characteristic of the rootstock used and was not influenced by the intermediate. Thus, when *P. serotina* roots were used as intermediates between Bartlett pear and quince rootstocks, no black-end developed. The inarching of Bartlett trees growing on *P. serotina* stocks with *P. communis* seedlings produced no change in the amount of black-end after 7-8 years, but where some *P. serotina* stocks were removed by sawing, leaving the trees standing on the inarches, the fruit produced subsequently was normal. Girdling the stocks with wire did not, however, check black-end, but ringing the stocks with a chisel stopped the production of black-end fruit after 1 to 2 seasons except in cases where the ring may not have been complete or where a callus bridge had caused reunion.

[2] Data collected from Bartlett trees growing on *P. communis* and *P. serotina* rootstocks indicate that there are rather large and consistent pH differences between mature black-end and normal fruits, the former being the more alkaline. The differences were found to be greatest in the calyx-end of the fruit, where the disease is nearly always localized, less for the mid-section and smaller still at the stem end. It is pointed out, however, that the data only indicate that there is a relationship between the hydrogen-ion concentration of the juice of the fruit and the presence of black-end; they do not indicate whether the differences are a cause, a result or simply an accompanying condition.

730. McLARTY, H. R.

634.11-2.19-1.8

Tree injections with boron and other materials as a control for drought spot and corky core of apples.

Sci. Agric., 1936, 16: 625-33, bibl. 17.

Thirty chemicals separately and in various combinations were injected into apple trees to test their influence on the occurrence of drought spot and corky core. When more than 0.48 grams of borate was used per 100 sq. cm. of trunk cross-sectional area, no drought spot occurred in the following crop. Corky core did not occur when more than 1.83 grams were used. The average crop of saleable fruit from trees treated with boron was increased in one year from 3.61 to 10.6 boxes per tree, whereas on the check trees there was a fall from 3.8 to 2.5. Though slight injury occurred at points of injection there was no foliage injury with BO_3 up to the highest amount used, i.e. 5.92 grams.

731. THOMAS, L. A. 634.11-2.19-1.415

Calcium deficiency in apple trees at Stanthorpe.

J. Coun. sci. industr. Res. Aust., 1936, 9 : 235-6, bibl. 3.

At Stanthorpe trees of Jonathan showing blotched foliage and Gravenstein trees with wine-coloured leaves were restored to normal by the application of quick lime to the soil either alone at 2 tons per acre or at 1 ton per acre after a previous dressing of muriate of potash $5\frac{1}{2}$ lb. per tree. The wine coloured leaves, however, can be produced in apple trees artificially by constriction of the bark. In this case the phenomenon appeared on gnarled trees. It should not be regarded as a reliable indication of lime deficiency.

732. JOESSEL, P.-H., AND LIDOYNE, A. 634.25-2.191

Essais de traitements contre la chlorose du pêcher. (Investigations of treatments for chlorosis in peaches.)

C.R. Acad. Agric. Fr., 1936, 22 : 306-11 and 315-20.

Iron salts used in the treatment of chlorosis may be applied to trees in several ways :—(1) By scattering on the soil around the trees, (2) by injecting a solution of iron salts, (3) by introducing crystals of iron sulphate into cuts made in the trunk or branches, (4) by painting over pruning wounds with a concentrated solution during winter, or (5) by spraying with a weak solution during the growing period. (1) The first of these methods is dismissed as giving inconsistent results and frequently failing owing to the rapid transformation of iron sulphate into unavailable forms, and also because of the large amounts of iron salts needed. (2) The liquid injection method, which has given satisfactory results on pear trees, has, however, proved unsuccessful with peaches owing to the rapid formation of gum in the injection holes. Extensive investigations were, therefore, limited to the last three methods. (3) Experiments on the introduction of solid particles of iron salts had as their objects the finding of a salt, which was more effective and less injurious to the trees than iron sulphate, and the determination of the best time to apply the treatment. A number of salts has been tested with various responses and accompanied by various degrees of injury, but, although the authors give the results briefly, they consider that it will be necessary further to investigate reactions before drawing definite conclusions. The time of application has proved important, the best results being obtained during periods when the sap is rising rapidly and during the winter, spring and beginning of autumn. Responses during the period of terminal bud formation have been weak. (4) Since the painting of pruning wounds with iron sulphate injures peach trees and is also laborious and slow, experiments were made to determine whether other salts might be substituted and whether they could not be applied to two slits about 10 cm. long made at the base of the branches. This method has been found to evoke stronger and more lasting response than has the treatment of pruning wounds. Of the salts tried the best results have been obtained from double tartrate of iron and potassium. This material produced practically no injury and the slits in the wood healed up rapidly. (5) Several salts were again tested as sprays, applied in equal concentrations in a single application towards the end of May, to determine if any might prove more satisfactory than iron sulphate. The best results were obtained with double sulphate of iron and ammonium. The response from iron sulphate was weak and from other salts ranged from fairly good to nil.

733. CASALE, L. 634.8-2.191

Sulla clorosi della vite e sui possibili rimedi. (Chlorosis of the vine and possible remedies.)

Ital. agric., 1936, 73 : 82-8, bibl. 7.

The author discusses at some length observations made by himself on the incidence of chlorosis in vines and the findings of Carsten Olsen in "Iron absorption and chlorosis in green plants", *C.R. Trav. Lab. Carlsberg*, 1935, vol. 21, No. 3. He makes the following recommendations for the avoidance of the disorder :—(1) The concentration of ferrous salts in the soil should be increased, either by direct additions of such salts to the soil or by such measures as may limit aeration in the soil. This proposal is based on results of Olsen's work. Olsen has found that in soil where soil aeration is checked, and hence the transformation of ferrous into

ferric compounds, chlorosis does not occur. This agrees with Casale's finding that the chlorotic power of the soil is lower, the lower the oxidation-reduction potentials of the soil and consequently the higher the concentration of ferrous ions due to reducing action. This fact also explains why in many regions calcareous soils are the worst for inducing chlorosis and are frequently incapable of amelioration in this respect even by heavy doses of ferrous salts. The soil in such cases is very friable, thus both inducing quick decomposition of organic matter with a consequent decrease of those dialysable compounds which iron forms with organic salts, and at the same time allowing a rapid change of ferrous into ferric salts. (2) The concentration of compounds formed between iron and the organic acids should be increased by the addition of appropriate manures or by green manuring, or even by the addition of the acids themselves. Casale is now trying the effect of adding sodium pyrophosphate to the soil. (3) The pH value of the soil should be modified as required. The soil pH which most favours chlorosis varies with all the other conditions affecting the degree of dispersion of the ferric-phosphatic compounds. Experiments are in progress to determine it under different conditions. (4) Once the pH signifying maximum chlorosis capacity has been determined, steps should be taken to increase or decrease the Ca or Mg content of the soil in the desired direction. Again this pH danger point should be borne in mind, if an attempt is made to ameliorate conditions by the addition of chemical fertilizers. (5) The vegetative growth of the plant should be encouraged by appropriate manuring. Nitrate of soda is particularly suitable since it renders the soil less permeable.

734. MILLER, P. W.

634.22-2.19

A report of progress on studies of prune russet ("scab") and its control.

Proc. annu. Mtg. Ore. St. hort. Soc. for 1935, 50, being 27th annu. Rep., pp. 106-22.

Prune russet or "scab" is manifested on the fruit as superficial, roughened or "scurfy", yellowish brown spots of various sizes and shapes, and is one of the major troubles affecting prunes in Oregon and Washington. It has been variously attributed to a number of different causes, but observations and preliminary investigations, made in 1935, indicate that it is non-parasitic, and that the principal, though possibly not the only, cause is mechanical injury due to the rubbing of twigs, etc., against the young developing fruits during windy weather. The critical period for the development of russet extends for about a month after calyx fall, and once the prunes are about three-fourths grown they appear to become highly resistant to russet development. Preliminary studies of possible control measures suggest that the incidence and severity of russet may be reduced by careful pruning, involving the removal of all dead wood and crossing branches, and by the establishment of windbreaks. No prune varieties so far as is known, are immune to the trouble, but it is noted that a local strain, known as Miller's Sweet, which possesses many Italian Prune characteristics, escaped serious damage from russet in 1935 when comparable trees of other varieties, including Italian Prune, bore a high proportion of russeted fruits.

735. GEORGE, E. J.

632.183

Growth and survival of deciduous trees in shelter-belt experiments at Mandan, N. Dakota, 1915-34.

Tech. Bull. U.S. Dep. Agric., 496, 1936, pp. 48, bibl. 14.

This bulletin deals with shelter-belt combination experiments with broad-leaved trees begun in 1915, which form only a part of the investigations conducted at the Mandan station. The objective was to determine the possibilities of growing trees on the northern Great Plains to provide shelter for farm buildings, orchards and gardens. Data on spacing distances, height growth, survival, adaptability, the congeniality of species and the optimum width for shelter belts were obtained from 22 shelter-belt combinations, growing under dry-land conditions. The climatic conditions in the area are characterized by extremes of temperature, limited rainfall, high winds and a high evaporation rate. Of 18 species of trees tested only 7, namely Chinese elm, *Ulmus pumila*; green ash, *Fraxinus pennsylvanica lanceolata*; box elder, *Acer negundo*; choke cherry, *Prunus virginiana*; Siberian pea-tree, *Caranga arborescens*; buffalo

berry, *Lepargyrea argentea* ; and American plum, *Prunus americana* have maintained satisfactory growth and survival. The side branches of box elder tend to suppress adjacent hedge species, and green ash, which does not develop spreading side branches, is more suitable for use next to these species. The cross section of a well-arranged shelter-belt should resemble an inverted V, the taller growing species being in the centre rows. In choosing spacing distances the object should be to maintain maximum growth and survival and eventually to develop overhead shade to a point approaching natural forest conditions. For orchard or garden protection 4 rows of trees are the maximum needed, but for farm-buildings at least 6 or 8 rows and on very exposed sites as many as 11 rows are wanted.

736. CHANDLER, W. H., AND HILDRETH, A. C. 632.111
Evidence as to how freezing kills plant tissue.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 27-35, bibl. 10.

In order to study the way in which freezing kills plant cells it was necessary to find an organism simple enough for the environment of a cell to be controlled and one whose death would be conclusively indicated by failure to grow. The most satisfactory organism tested proved to be certain kinds of pollen, and the kinds used came from Lukens Honey peach, Himalaya blackberry, a variety of amaryllis and a variety of yellow antirrhinum. All these pollens showed a high percentage germination after being held dry for several days at -15° to -17° C., and samples for all treatments were kept at these temperatures until used. Results are described in detail. Pollen covered with freezing water became turgid during the 1.5 minutes which elapsed before all the water froze, and when left at -15° to -17° C. was nearly all killed in about 20 minutes. Pollen coated with castor oil or with Wesson oil as it came from the anthers, placed on ice and covered with freezing distilled water and kept at -15° to -17° C. was uninjured. Pollen held at -15° to -17° C. in approximately saturated solutions of sucrose and dextrose was not injured until the sugar and water were crystallized rather firmly. Finally pollen held at -15° to -17° C. in concentrated peach bark sap was not injured nearly so much as the pollen held at the same temperatures in the ice of distilled water, although at room temperature the sap killed practically all the pollen in a short time. These results are discussed in the light of opinions held by Maximow, Molisch, Gorke, Müller-Thurgau and others, and it is concluded that the evidence obtained appears to support Maximow's view that killing of protoplasm at low temperatures is not due to the concentration or changing of the sap caused by freezing out of the water, but is due to a direct effect of the ice masses such as pressure on the protoplasmic membrane.

737. LEVITT, H. J., AND SCARTH, G. W. 632.111 : 581.11
Frost-hardening studies with living cells. I. Osmotic and bound water changes in relation to frost resistance and seasonal cycle ; and II. Permeability in relation to frost resistance and the seasonal cycle.

Canad. J. Res., 1936, 14 : 267-84, bibl. 44, and 285-305, bibl. 14.

The present papers are the first of a series of studies on frost resistance of plants in which resistance of living plant cells will be discussed as distinct from the more usual method in such investigations of studying the properties of tissue extracts. Though great increases of resistance power can be obtained in the process of hardening against frost so that cells ordinarily sensitive to a few degrees of frost may become capable of withstanding -40° to -80° C., yet the mechanism by which this resistance is achieved is still largely a mystery. The authors summarize as follows :—The osmotic pressure and non-solvent space of the cells of various types of plant were estimated by the plasmolytic method [using calcium chloride in place of potassium salts, and thus preventing change in osmotic pressure. Ed.] and related to frost resistance and the seasonal cycle. Osmotic pressure always rises with hardening and falls with dehardening, and it generally reaches higher values or begins to rise earlier in the hardier species and varieties. The effect of osmotic pressure in reducing the amount of ice formation is enhanced in woody plants by the condition that only about half the cell volume is occupied by the osmotically active solution. The remainder, i.e. the non-solvent space, is shown to consist partly of bound water and must, therefore, represent hydrophilic colloid. This occupies an even larger proportion of

the sap vacuole than that of the protoplasm, and it increases notably with hardening. This change, besides reducing intercellular ice, is regarded as protecting the most vulnerable part of the cell, viz., the vacuole, from being frozen at very low temperatures. II. Permeability is found to increase greatly with hardening, whether induced by low temperature or other conditions and it seems to parallel closely the seasonal changes in frost resistance. As regards different species and varieties, cell permeability in the hardened state shows better correlation than any other character with ability to resist frost. The permeability change is greatest towards potassium nitrate—at least in cells (viz., those of hardy woody plants) that are definitely permeable to the salt; the change is more moderate towards polar non-electrolytes with small molecules such as urea, but with these it occurs in all plants capable of hardening; towards apolar substances, such as urethane, there is no change. These relations point to a widening of the aqueous pores or increased hydration of the plasma membrane as the mechanism of the permeability increase. Hypotheses [see *A* and *B* below. *ED.*] are put forward as to the means by which freer permeability to water may increase resistance to certain types of mechanical injury by frost. [End of authors' summaries.] *A, Quick freezing.* Here the damage is caused by ice formation inside the cells which can only occur if the cell sap is cooled faster than its freezing point is lowered by concentration of the sap. The concentration occurs because crystallization begins outside the cells and the water is drawn from the cells to form the crystals. Thus the faster the water can escape from the cells the less the danger of intercellular freezing. *B, Slow freezing.* On occasions large crystals are formed which, there is evidence to conclude, press upon the cells and force them apart. These large crystals are the result of slow exosmosis from the cells. In rapid exosmosis smaller crystals are formed which are less injurious. Thus a higher rate of permeability to water would minimize mechanical damage by reducing crystal size. Hardy plants are characterized by small cells which facilitate the rapid exit of water and large ice masses do not form in hardy plants. This, the authors conclude, perhaps explains how plants are hardy.

738. WENZ, H. 634.21-2.111
Spätfrostschäden an Aprikosenblättern. (**Late frost damage to apricot leaves.**)
Gartenbauwiss., 1936, **10**: 247-55, bibl. 7.

The author's observations in Austria on plums, apricots and other fruits lead him to consider that the phenomenon on apricot leaves described by Solejeder and Noack as "frost blisters" may also be due to other as yet unknown causes. These "blisters", first reported in 1903, appear on the under side of the leaf as whitish spots, equally distributed over the whole leaf surface or in many cases they appear only round the basal part of the chief leaf veins. The white colour is due to light reflection, an air space being formed by the lifting up of the lower epidermis from the mesophyll. As in the case of apple frost blisters the cells of the mesophyll grow out in the form of hairs into the air space above. In such cases most of the leaves remain quite smooth above, but in others, where the phenomenon is seen only round the main vein, malformation of the leaf surface occurs. As the result of the late May frost in 1935 the damage to apricot leaves was seen partly in a more or less regular dying back of the leaf margin, partly in a shot hole effect due to the death and fall of small round bits of leaf area. A further result of frost damage is the irregular surface growth of particular parts of the leaf area, which results in an irregularly crinkled leaf surface.

739. LUTZ, J. M. 632.111 : 634.11 + 633.491 + 635.25
The influence of rate of thawing on freezing injury of apples, potatoes and onions.
Proc. Amer. Soc. hort. Sci. for 1935, 1936, **33**: 227-33, bibl. 7.

Apples, potatoes and onions were frozen at 16° to 17° F. for various periods and were then subjected to thawing temperatures ranging from 30° to 95° F. All three products were generally more severely injured with more rapid thawing, although with apples and onions the effect did not become very marked until a temperature of 95° F. was used. The injurious effect of high

thawing temperatures was accentuated when apples were held at these temperatures beyond the period necessary to complete thawing. The author points out that his results were obtained from products placed in direct contact with the freezing and thawing media, and could not, therefore, be directly applied to the same products when commercially packed. He considers, however, that the results of this and previous work suggest that a thawing temperature of 40° F., adjacent to the frozen product, would be most suitable for apples, potatoes and onions when packed under commercial conditions.

740. NIXON, E. L. 634.13-2.314
Blight-resistant pear.
Forty-eighth annu. Rep. Pa agric. Exp. Sta. for 1934-5 (being Bull. 320), pp. 18-9.

A new pear which has proved wholly immune to fireblight in spite of repeated inoculations has been named Richard Peters. The variety is self-sterile but vigorous and productive when properly cross-pollinated. The fruit resembles Bartlett in appearance and quality. Its chief value, however, may be as a progenitor of other blight resistant varieties, and possibly as a blight resistant stock, if vegetative propagation is possible. Seedling plants with Richard Peters as a parent are already being grown.

741. HUBER, G. A. 634.11-2.4
The fungous flora of normal apples.
Res. Stud. St. Coll. Wash., 1935, 3 : 26-8.

Apples are mainly contaminated with fungus spores present in the air in the orchards. Those most commonly present are *Cladosporium*, *Dematium*, *Alternaria*, *Mucor*, *Aspergillus*, the counts of spores of all kinds per apple ranging from 14,000 to 159,100. Overhead irrigation gave counts of 119,616 spores per apple against 36,766 spores for surface irrigated trees. Contamination after picking may result from dirty picking boxes; 108,050,160 spores were averaged on the inside of 6 boxes, while the inner surface of the bottom boards only of one box carried 109,958,400 spores, about a third being *Penicillium* types. The air of packing houses was highly contaminated, but much less so where sanitary measures were applied. Gloves worn by sorters gave 12,100 to 40,000 spores per square inch of palm. The processes used for the removal of arsenical residue failed to reduce spore load. Apples from 4 important apple growing districts bore 124 species or forms of 29 genera (and 23 unclassified) of which 58 were found capable of causing decay, some of these being so reported for the first time.

742. SCHMIDT, M. 632.42 : 634.11
Venturia inaequalis (Cooke) Aderhold. V. Weitere Untersuchungen über die auf verschiedenen Bäumen lebenden Populationen des Apfelschorfpilzes.
(The apple scab fungus. Further investigations on the populations living on different trees.)
Gartenbauwiss., 1936, 10 : 422-7.

A large number of single spore cultures (90-97 each) were isolated from 4 apple trees growing close together (2 Belle de Boskoop, 1 Kaiser Wilhelm and 1 Muskatt Reinette) and 1 Belle de Boskoop growing some 540 yards away. Out of 473 isolations it was possible to differentiate 448 morphologically different forms. From this fact and from the distribution and frequency of the same types on different trees it is concluded that there can be no connexion between the composition of the population living on one tree and its kind of habitat. Further, particular populations are not restricted to particular hosts. What is important for the composition of the *Venturia* population forming colonies on any tree are merely the chance alterations in environmental conditions which affect the incidence of scab and its distribution in connexion with the remarkably large number of forms taken by it.

743. HOLZ, W. 634.11-2.42
 Biologie und Bekämpfung von *Fusicladium dendriticum* 1935. (The biology of the apple scab fungus [*Venturia inaequalis*.—Ed.] and its control in 1935.)
Forschungsdienst, 1936, 1: 362-8, bibl. 14.

The author discusses the varying results in Europe and America of scab control measures in 1935 and the generally expressed wish for a decrease in number of treatments. He notes that environment and weather conditions have a great influence on scab and that contradictory results from similar treatments may be attributed to differences in these factors. He considers also that investigations on the biology of the fungus should continue and may prove important in devising control methods. The discovery of a very large number of strains of scab would appear to make the breeding of resistant apple varieties more complicated, although the efficacy of chemical control methods does not appear to vary on that account. Holz has now evolved a successful method of colouring the mycelium in green apple leaves. The process is as follows:—The green leaves are boiled in 20% KOH, until fully transparent; they are then differentiated for a short time in 96% acetic acid and coloured first with gentian violet and then with cotton wool blue (Gage). The leaf nerves then show up bright blue and the mycelium reddish violet. A further simplification has done away with the necessity for the use of the gentian violet. This method enables the fungus to be visible at every stage after infection and should allow the question to be answered as to whether primary infection starts from ascospores or conidia. Actually it allowed Holz to determine that in one particular orchard under examination primary infection was due entirely to ascospores. Biologic investigations of the fungus, together with the correlation of the results of different control methods with environmental and climatic factors and possibly the breeding of resistant varieties should result eventually in the satisfactory suppression of this disease.

744. HERBST, W. 632.42.634.13
Venturia pirina Aderhold. I. Zur Formenmannigfaltigkeit des Pilzes.
 (Multiplicity of strain in *V. pirina*.)
Gartenbauwiss., 1936, 10: 428-50, bibl. 9.

Several thousand single spore cultures from different hosts growing in different localities were raised in artificial culture by uniform technique and their forms were noted. In populations obtained from 30 varieties of pear very many variations in form were found to exist. A classification of types was made, based on colour and form of culture. It appears probable that leaves and fruits do not possess specific forms. The populations of different pear districts are of different composition. Each district possesses not only types common elsewhere but also its own particular types. The question of the possibility of the occurrence of forms typical of varieties must, despite certain indications to that effect, remain undecided until settled by artificial infections. Mutations occurred to a relatively high extent in the artificial cultures, even albinos and quite different forms appearing sometimes. The final form would appear to be represented by a dark brown type. The frequency of sporting forms, which, we think, might partly be attributed to the vegetative division of the cell nucleus, would to a certain degree explain the multiplicity of forms in *V. inaequalis*. [Author's summary.]

745. BAKER, K. F. 634.11-2.48
 Investigations on the etiology and control of the blue-mold decay of apples caused by *Penicillium expansum* Link.
Res. Stud. St. Coll. Wash., 1935, 3: 32-3.

Lenticel infection of blue-mould was dependent upon a combination of favourable factors of which the order in decreasing importance was the number of susceptible lenticels, the number of blue-mould spores on the fruit and the operation of factors influencing infection, e.g. volatile products of the fruit, exosmosis of nutrients through uncutinized lenticel cells, juice of decayed fruit and the acid condition of moisture on the surface. Delayed picking, cold storage with subsequent washing in hot solutions (43°-49° C.) and severe bruising increased the number of susceptible lenticels. Harvested fruit held dry at orchard temperatures or given dry heat treatment of 30° C. for 10 days showed decreased lenticel infection. Lenticel infection by contact with decayed apples was due to enzymic action on the uncutinized cells of susceptible lenticels

as well as to the stimulus of spore germination. Cold storage retarded development, but did not prevent infection. The main source of infection is the packing house and its accessories and disinfection alone can control this. Spraying with sodium hypochlorite solution having 0.4% available chlorine disinfected equipment. Copper sulphate was inadequate. Dipping in hypochlorite solutions of the above strength for one minute reduced spore load and percentage of decay and did not impair fruit and flavour. [The subject is treated at greater length in Baker, K. F., and Heald, F. D. An investigation of factors affecting the incidence of lenticel infection of apples by *Penicillium expansum*. *Bull. Wash. St. agric. Exp. Sta.* 298, 1934, pp. 48, and *idem*, Investigations on methods of control of the blue-mold decay of apples. *Bull. Wash. St. agric. Exp. Sta.*, 304, 1934, pp. 32.—ED.]

746. KIVILAAN, A. 632.42 : 634.11

Viljapu-seenvähk, *Nectria galligena* Bres., selle esinemisest Louna-Eestis ja tõrjest. (Prevalence and control of canker on apples in S. Estonia.) [Esthonian, English summary.]

Katseasj nõuk. Toim. Tartu (Bull. Phytopath. Exp. Sta. Univ. Tartu), 44, 1935, pp. 52, bibl. 70, reprinted from *Agronomia*, Nos. 10-12, 1935.

The various parasitic *Nectrias* found on apple trees in S. Estonia are described. *N. galligena* is the most prevalent, attacking 31.2% of trees in country and 73.9% of the trees in town orchards. It is definitely a wound parasite. A list is given of the varieties and of the percentage of trees within those varieties which are most susceptible.

747. DU PLESSIS, S. J. 632.482 : 634.87

Studies on the wastage of export grapes with special reference to that caused by *Botrytis cinerea* Pers.

Sci. Bull. Dep. agric. S. Afr., 151, 1936, pp. 163, bibl. 123, being *Sci. Bull. Coll. Agric. Stellenbosch*, 24.

Studies were made in the laboratory and field. From the former it was concluded that the differences observed in seven monospore isolates of *Botrytis* taken from pears, apples, quinces and grapes were sufficient to consider them as being different varieties of *Botrytis cinerea*. In the field *Botrytis* infection was favoured by high humidities and *Botrytis*, *Penicillium* and *Cladosporium* by mechanical injuries to the grapes. Heavy or late applications of nitrogenous and to some extent potassic fertilizers increased and phosphatic fertilizers decreased susceptibility of Henab Turki grapes to wastage infection. Grapes picked in the afternoon and packed the following day showed least amount of *Botrytis* rot. *Botrytis* storage was controlled best by Verderame sulphur dust and *Penicillium* by copper sulphur dust but the effects of all fungicides diminished in proportion to the amount of mechanical damage to the fruit. The shorter the period between copper sulphur dusting and rainfall and the longer the period between rain and picking, the greater is the efficiency of this treatment. Sodium metabisulphite or ammonium carbonate crystals added to bunches of Henab Turki before wrapping controlled rot but extensively damaged the grapes. Dipping in formalin and ammonia solutions gave fair control but proved cumbersome and messy. All chemically treated wrappers tried, with the exception of iodized wrappers, were useless. The latter, however, gave considerable control and are recommended. Sulphur dioxide gas adversely affected appearance and flavour. A satisfactory fumigation treatment was a 4% (volumetric) concentration of formaldehyde for 1 hour, though some varieties were susceptible to damage. Spraying the woodwool box linings with this solution just before packing was effective, particularly with unwrapped grapes. So, too, was spraying the actual bunches, but packing wet grapes is always conducive to wastage. Ripe grapes were found to be more susceptible to wastage than the less mature. Delaying packing in order to cater for the late overseas market is, therefore, unwise.

748. BERKELEY, G. H.

634.711-2.4

Root rots of the raspberry.

Canad. J. Res., 1936, 14 : 306-17, bibl. 36.

The paper discusses certain fungi, isolated from naturally infected raspberry roots in Ontario and British Columbia, which are capable of producing necrotic lesions on healthy roots.

749. JOESEL, P.-H. 635.61 : 632.4
 Essais de traitements contre les maladies du melon—en 1934, and ditto
 (Année 1935). (Trials of control measures for melon diseases.)
Ann. Epiphyt. for 1934-5, 1936, 1 (n.s.) : 81-101, and *Ibidem for 1936, 1936,*
2 (n.s.) : 21-30.

Two serious melon diseases, Oïdium or powdery mildew disease caused by *Erysiphe cichoracearum* D.C., and anthracnose or "nuile" caused by *Colletotrichum lagenarium* P. (Ell. and Huls.), have been the subject of control experiments in the neighbourhood of Avignon over a period of 3 years. Results obtained in 1933 were published earlier.* The present papers present results of spraying and dusting trials made in 1934 and 1935 on the variety "Cantaloup Charentais". In 1934 three applications were made between 21 August and 21 September of each of six sprays :—Bordeaux mixture, lime-sulphur, a mixture of these two sprays, a copper oxychloride suspension, a mixture of potassium permanganate and lime, and a lime wash. The proportion of fruits attacked by anthracnose was appreciably reduced by all treatments in comparison with an unsprayed control plot, and the best results were obtained with bordeaux mixture. Similarly the development of Oïdium on the foliage was retarded on all the sprayed plots, the greatest measure of control being exerted by bordeaux mixture, the bordeaux-lime-sulphur mixture, lime-sulphur and the copper oxychloride suspension. An increase in yield and in the average weight of the fruits as well as a marked improvement in quality followed the applications of bordeaux and bordeaux-lime-sulphur mixtures and to a less extent that of lime-sulphur alone. The cost of spraying with bordeaux mixture was amply repaid by the better price obtained for the crop. In 1935 the experiments were continued with the same sprays and with some other spraying materials and dusts. Against Oïdium the effectiveness of bordeaux mixture was confirmed and the bordeaux-lime-sulphur mixture gave better results than in 1934. Lime-sulphur, used at a higher concentration than in the previous year, caused no injury to the plants and gave control nearly equal to that of bordeaux mixture. Neutral hydroxyquinoline sulphate proved slightly better than potassium permanganate but inferior to two dyes, namely malachite green and phosphine. Copper sulphide unexpectedly proved inferior. The alternate application of bordeaux mixture and lime-sulphur gave slightly better results than the exclusive use of either. A dust consisting of copper sulphate and talc proved much inferior to either of these sprays, while another dust consisting of sulphur, neutral verdigris, talc and a sticking agent, though better, requires further testing.

750. ADAMS, J. F., AND NIKITIN, A. A. 632.952.2
A new copper fungicide.

Trans. Peninsula hort. Soc. for 1935, 1936, 25 : 5 : 73-80.

The new fungicide may be classified chemically as a synthetic copper zeolite. It contains approximately 25% metallic copper in combination with ingredients which render it non-hygroscopic and non-caustic. The details of the chemical and technical studies through which it was evolved are to be presented later by the junior author. In the present paper its more important properties are noted as follows :—It requires no spreader or sticker and produces a very smooth, adherent, spray film without any conspicuous residue ; it is compatible with lime-sulphur, wettable sulphurs, ordinary arsenicals, oil sprays, pyrethrum, derris, and nicotine products in general ; and chemically it is very stable, retaining its physical and chemical properties when subjected to weathering. During 1934 and 1935 the new fungicide was tested against other copper and sulphur sprays in two apple orchards, with particular reference to the control of scab, caused by *Venturia inaequalis*, and fruit spot, caused by *Phoma pomi*. Better control of both diseases and also of sooty blotch and fly speck was obtained from applications of the new fungicide, and copper russetting of the fruit was reduced by comparison with that associated with other copper sprays. It is concluded that for average conditions a concentration of 1 lb. per 100 gallons water should give effective scab control, but where scab has been severe or where bitter rot and apple blotch are troublesome a concentration of 1½ lb. per 100

* *Progr. agric. vitic.*, 1933, 100 : 599-603.

gallons diluted spray should be used in pre-blossom applications. Thus it is seen that under normal conditions fungus disease control may be attained with only about one-half the quantity of metallic copper that is generally used in bordeaux mixtures.

751. KLOTZ, L. J. 664.85.3 : 632.952
Nitrogen trichloride and other gases as fungicides.
Hilgardia, 1936, 10 : 27-52, bibl. 23.

Valencia oranges were inoculated with *Penicillium italicum* (blue-mould) and *P. digitatum* (green mould) and were afterwards treated at intervals during storage with gaseous mixtures of nitrogen trichloride, NCl_3 . Checks were provided by treatment with warm soap solutions. It was found that, after 3-4 weeks' storage, losses due to decay were reduced by 50 to 75% by 3 to 5 3-hour treatments with concentrations of 5 to 15 mg. NCl_3 per cubic foot of air, when treatment was begun on the first day of storage and repeated at 3- or 4-day intervals. In laboratory tests concentrations as low as 4 to 6 mg. NCl_3 per cubic foot for a period of 30 minutes proved lethal to conidia of the two *Penicillium* spp. and also to conidia of *Oospora Citri-aurantii*, *Colletotrichum gloeosporioides*, *Alternaria Citri* and *Botryosphaeria Ribis*, and to the mycelium of *Phytophthora citrophthora*. A procedure for the safe and effective use of NCl_3 treatment in storage rooms and refrigerator cars is outlined, and it is noted that installations of apparatus have been made in the plants of 15 packing companies. Preliminary trials indicate that grapefruit and lemons may also be successfully treated by the use of lower concentrations of the gas for long periods. Among other gases investigated chlorine proved more toxic to the fungi in cultures and may be used for general disinfection of packing houses and equipment, but when used for fruit at the same concentrations as NCl_3 it proved injurious and was much less effective in decreasing decay. Ozone showed very slight or no toxicity to *Penicillium* organisms and afforded no protection to oranges. Monomethylchloramine, CH_3NCl_2 , in preliminary tests proved to be at least as effective as, and possibly superior to, NCl_3 in sterilizing the surface of the fruit, but the cost of preparing it was greater. Sulphur dioxide injured the rind of the fruit at all effective combinations of concentration and periods of exposure so far tested, but it may be used effectively in the sterilization of boxes and for general disinfection purposes in the packing-house.

752. GROVES, A. B. 632.952
Fungicides in relation to foliage injury and fruit yield.
Trans. Peninsula hort. Soc. for 1935, 1936, 25 : 5 : 58-60.

In a short general discussion of fungicides in relation to foliage injury it is mentioned that where lime-sulphur is used with lead or calcium arsenate the best corrective has been found to be a good grade of fresh hydrated lime used at double the rate of the arsenate. Bordeaux mixture is an effective corrective for soluble arsenic, and should always be included where calcium arsenate is used, whether or not there is need for it as a fungicide. In noting briefly the relationship between foliage injury and fruit yield a table is given showing that in some experimental plots in Virginia the weight per 1,000 fruits of the apple variety Gano was distinctly reduced by the use of lead arsenate alone rather than copper and sulphur fungicides, and was even slightly less than that of fruit from unsprayed check plots.

753. DE CASTELLA, F. 634.836.72
Phylloxera-resistant vine stocks (V).
J. Dep. Agric. Vict., 1936, 34 : 303-9.

Parts I to IV were noted in *H.A.*, 1936, 6 : 1 : 50 and 6 : 2 : 287. The degree of resistance to *Phylloxera* of many supposedly immune varieties is discussed and is shown to be largely governed by environment and by the degree of compatibility with the scion. The scale of resistance of stocks drawn up by Viala and Ravaz in 1896 is compared with that of Foex, 1899. A warning is given that two of the most successfully resistant and largely planted stocks in Victoria, namely No. 1202 and A.R.G.1, are only credited with qualified resistance in California, while in S. Africa A.R.G.1, there called Aramon No. 1, is completely discredited. Stocks of Americo-vinifera origin should be regarded with suspicion.

754. SCHOLLES, W. 632.753 : 634.11
 Die Bekämpfung der Blutlaus *Eriosoma lanigerum* Hausmann durch Blausäure.
 (HCN control of woolly aphis.)
Obst. u. Gemüseb., 1936, 82 : 3-5.

Laboratory experiments were made on cut apple branches heavily infested with woolly aphid. There were two series of experiments. In the first the temperature of the gas compartment was 10°C. (50°F.) and the relative humidity 85-87%, the concentrations of gas being 0.75, 1.0 and 1.5 grams CN per M³, while in the second the temperature was 15°C. (59°F.), relative humidity 82-84% and gas concentrations 0.25, 0.5 and 1.0 grams CN per M³. Controls were used in all cases. In both series exposures were made for 15, 30, 45 and 60 minutes. The author summarizes his results as follows:—Complete destruction of woolly aphid can be achieved by exposure to HCN gas in an air-tight gas chamber for 1 hour at a concentration of 1.0-1.5 grams CN per M³ with a temperature of from 15-10°C. The temperature is a very important factor. The higher it is, the lower is the minimum HCN concentration necessary. Neither leaves nor branches were affected by the treatment. These experiments show that the aphid can be killed by HCN and it remains for field experiments to show whether similar success can be obtained in the orchard and if so what concentrations are necessary. Field experiments are planned.

755. SOULIÉ, H. 632.78
 La lutte contre le ver des pommes dans le Puy-de-Dôme. (Codling moth control.)
Ann. Epiphyt., 1936, 2 : 159-89, bibl. 57.

The methods used in the Puy-de-Dôme in controlling the codling moth are described and comparisons drawn with American methods, from which the French grower has learnt much and has still much to learn. The numerous references are freely drawn upon in the discussion.

756. ANON. 634.1/8-2.95
 Lutte contre les parasites des arbres fruitières. Calendrier des traitements.
 (A calendar of control measures against fruit tree pests.)
Publ. Serv. Défense Végétaux, Rabat, Morocco, 10 (2nd edit.), 1935, 1 sheet.

The publication consists of a chart arranged under the headings:—Stage of growth, pests to be controlled, control measures, and remarks, for each of four groups of fruit trees, namely oranges and other citrus fruits, apples and pears, peaches and almonds, and apricots and plums. By glancing down the columns it is a simple matter to trace the sequence of control measures to be adopted in the course of the different seasons of the year. It may be noted, however, that no formulae are given for the majority of the recommended sprays and dusts.

757. ANON. 635.61 : 632.76
 Les coccinelles du melon (*Epilachna chrysomelina* F. et *Epilachna argus* Geoff.) (Coccinellid beetles attacking melons.)
Memento, Serv. Défense Végétaux, Rabat, Morocco, 36, 1936, pp. 5.

These two species of coccinellid beetles attack melons in Morocco, but this paper is concerned only with *Epilachna chrysomelina*, which appears to have the wider distribution in that country. The insect is described with the help of illustrations and its life history outlined. It attacks the leaves, stems, flowers and fruits of the melon, but more particularly the leaves, and the two principal periods of infestation are the spring, when hibernating adults become active at the time the young plants are pricked out, and June and July, when adults of the second generation emerge. Control measures include the destruction of cucurbitaceous weeds which may harbour the insects, early transplanting to allow the plants to become established before over-wintering beetles emerge, and the destruction of fallen leaves and plant debris after harvest. Sprays have so far proved ineffective owing to the difficulty of wetting melon plants satisfactorily, but two dusts, one a mixture of talc 75% and barium fluosilicate 25%, and the other of sodium fluosilicate 50%, gypsum 45% and nicotine sulphate 5%, have given excellent results. A commercial dust with a derris basis has also been reported to have given satisfactory results in Tunis.

758. FLEMING, W. E., AND METZGER, F. W. 632.76
Control of the Japanese beetle on fruit and shade trees.
Circ. U.S. Dep. Agric., **237**, 1936*, pp. 11.

This circular is a complete revision of *Circ.* 237 as originally issued and supersedes *Circ.* 317†. After noting the areas infested and the trees attacked by the Japanese beetle, the authors describe sprays for controlling the pest on early and late apples and peaches and on plums, cherries, grapes, small fruits and shade trees.

759. FILINGER, G. A. 632.78
Variations in the effectiveness of chemically treated codling moth bands.
Proc. Amer. Soc. hort. Sci. for 1935, 1936, **33** : 191-4.

Experiments made in Kansas during the period 1933-35 are reported, and the following conclusions are drawn :—(1) Chemically treated codling moth bands are less effective in killing larvae during seasons of above-normal temperatures. (2) A high beta naphthol content in the bands is more effective than a low. Where high beta naphthol is used, tree trunks can be protected with asphalt emulsion, water glass or linseed oil. (3) 4-inch bands, unless very carefully dipped, are less effective than 2-inch bands. (4) The addition of aluminium stearate to beta naphthol and oil makes the chemicals sticky, and such bands are more effective than those in which the beta naphthol becomes dry and crystalline.

760. SCHROEDER, R. A. 634.11.581.13 : 632.95
The effect of some summer oil sprays upon the carbon dioxide absorption of apple leaves.
Proc. Amer. Soc. hort. Sci. for 1935, 1936, **33** : 170-2, bibl. 5.

Carbon dioxide absorption was found to be reduced to a greater extent as both the viscosity and the percentage of oil in sprays was increased. This applied in particular to a comparison of oils of 55 and 80 Sec. Saybolt viscosity, and there was little difference between oils of 80 and 110 viscosity. Evidence is also presented to show that a second spray application causes a further reduction in CO₂ absorption, and that with vegetable oils the recovery of the leaves was less than with mineral oils.

761. POOLE, R. F. 634.25-2.951.23
Further observations on the relation of zinc sulfate on the control of arsenical injury on the peach.
Proc. Amer. Soc. hort. Sci. for 1935, 1936, **33** : 183-5, bibl. 1.

May and June 1935 were exceptionally dry months in N. Carolina, but July, the harvest month for peaches, was unusually wet and cloudy. Under these conditions fruit sprayed with lead arsenate in mid-June developed very severe injury, and the addition of zinc sulphate to the spray reduced the injury only slightly, proving less satisfactory than ammonium copper silicate, red copper oxide and copper phosphate used with fused bentonite sulphur. It may be advisable, therefore, to use basic arsenate of lead or reduced amounts of arsenate during drought seasons in the last application about 4 weeks prior to harvest. Leaves and buds were not injured at any time.

762. CHRISTOPHER, E. P. 634.11 : 581.13 : 632.952
The effect of flotation sulphur spray on the CO₂ assimilation of apple leaves.
 PICKETT, W. F.
A comparison of three methods of measuring photosynthetic activity of apple leaves.
 HOFFMAN, M. B.
The effect of lime sulphur spray on the respiration rate of apple leaves.

* First issued 1932, revised 1936.

† Abstracted *H.A.*, 1934, 4 : 4 : 585.

CLORE, W. J.

The effect of bordeaux, copper and calcium sprays upon carbon dioxide intake of Delicious apple leaves.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 149-51, bibl. 4, 152-4, 173-6, bibl. 3, and 177-9, bibl. 5.

[1] Determinations of CO_2 assimilation by leaves of a McIntosh tree growing in the orchard and Baldwin trees growing in a glasshouse indicate that, when the leaves are sprayed on both surfaces with 1-55 flotation sulphur, CO_2 assimilation is reduced, but that the reduction is not nearly so serious as that reported to result from applications of lime-sulphur.

[2] The author discusses and criticizes very briefly the results obtained when the photosynthetic activity of Delicious and Livland apple leaves was measured by three different methods. The first of these depends upon the quantitative determination of the carbon dioxide absorbed by a known amount of leaf area; the second is based upon the determination of organic substances formed or the dry matter accumulated by a unit of leaf area during a definite period; and the third involves comparisons of the total hydrolyzable carbohydrate at different periods of the day.

[3] Experiments indicate that there is a tendency for apple leaves sprayed with lime-sulphur to show a slightly greater rate of apparent respiration than untreated leaves. Such an increase, however, would fail entirely to compensate for decreases in the rate of photosynthesis produced by the spray, and it is, therefore, concluded that it is this latter effect which is principally responsible for lime-sulphur injury to leaves.

[4] CO_2 assimilation was estimated in Delicious apple leaves sprayed with 4-4-50 bordeaux mixture, 4-0-50 copper sulphate and 0-4-50 hydrated lime. Compared with unsprayed control leaves, the calcium-sprayed leaves showed a marked decrease in CO_2 assimilation, but there was no significant alteration in assimilation rates of the bordeaux or copper sulphate-sprayed leaves. Burning developed on some of the calcium-sprayed leaves, and typical bordeaux injury on the copper sulphate-sprayed leaves.

763. MENZEL, K. C. 632.951.1
 Versuche zur Verbesserung nikotinhaltiger Spritzmitteln. (*Investigations on the improvement of nicotine sprays.*)
Angew. Bot., 1936, 18 : 22-6.

A brief description of work carried out at the Botanical Institute of the Technical High School, Dresden.

764. DRAIN, B. D., AND OTHERS. 632.951.1
Further experiments with high test pyrethrum strains.
 EVANS, L. E., AND OTHERS.
Pyrethrum plant investigations in Colorado, III : Effect of spacing interval in the row on yield of flowers.
 EVANS, L. E., AND OTHERS.
Pyrethrum plant investigation in Colorado, IV : Effect of different irrigation practices on plant losses due to crown rot.
Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 201-4, bibl. 1, 205-6, bibl. 2 and 207-9.

[1] Further evidence of the probable value of high test vegetative strains of pyrethrum is presented. Although there are indications that environment may have some influence, selected strains should remain high test, if kept free from mixing with volunteer seedlings and sports.

[2] With 30 inches between rows of pyrethrum transplanted to the field in May, yield per acre of flowers by weight decreased progressively with wider spacing in the rows from 9 inches to 24 inches at 3-inch intervals. In 9-inch plots the flower stems were more upright than in 18-, 21- and 24-inch plots, in which the stems tended to spread and lodge, a factor to be considered in harvesting.

[3] Preliminary results from two seasons' study indicate that plant losses due to crown rot can be reduced under irrigated conditions by using furrows 6-8 inches deep, placed 10-15 inches from the plant rows, so as to keep the surface soil around the plants dry, in place of shallower furrows placed nearer to the rows. The soil should be ridged around the plants to permit of excess rain water draining towards the irrigation furrows.

VEGETABLES AND HERBS.*

765. CORDNER, H. B. 635.64 + 635.63 + 635.611

Recent results on vegetable variety trials in Maryland.

Trans. Peninsula hort. Soc. for 1935, 1936, 25 : 5 : 65-72.

Tomatoes :—The results of a three-year test with 8 main-crop or canning varieties completed in 1928 were described in *Bull.* 318 of the Maryland Experiment Station. Marglobe and Greater Baltimore were the most productive varieties in these trials, which have subsequently been continued so as to include some of the newer varieties. Yields for 1934 and 1935 are tabulated and show that Pritchard as well as Greater Baltimore and Marglobe proved distinctly superior to 7 other varieties tested. Trials with 4 early tomato varieties in 1935 are also noted, but do not appear to show any very marked superiority of one variety over the others. **Cucumbers** :—Trials were started in 1935 using the variety Clark's Special as a standard check. In the first year, A.C., Clark's Special, Woodruff's Hybrid and Klondike have given significantly higher yields than 5 other varieties. Although there were no significant differences between these four varieties, Klondike may be regarded as possessing certain inferior characteristics. **Cantaloupes** :—The first year's results with 9 varieties, using Hales Best as a standard check, are tabulated. **Watermelons** :—Trials made in 1935 have shown wilt-resistant varieties to be fully as productive as other varieties. Of 5 resistant types Pride of Muscatine appears to be the best. The fruit characteristics of some of the other varieties are noted briefly. **Other crops** :—Variety trials with sweet corn and Lima beans are also described.

766. ADAMS, J. 633.88

Medicinal plants and their cultivation in Canada.

*Publ. Canad. Dep. Agric., 484, 1936, being *Fmrs.' Bull.*, 4, pp. 29, bibl. 6.*

The supply of certain wild plants of medicinal value in Canada and the U.S. has in some areas been very largely depleted by continuous collecting, and, if future demands are to be met, these plants must be cultivated. This paper is, therefore, designed to assist farmers who may wish to devote a small area of land to these crops. Some general hints are given on soil, climate and cultivation, and on collecting and drying the crop, and notes are supplied on the growing of 18 medicinal plants for which there is a considerable demand, and of 17 which are required in smaller quantities. The major botanical characters of most of these plants are described, and in addition 16 of the plants are illustrated to help the grower who obtains his first stock from wild specimens to avoid collecting wrong species.

767. HUTCHINS, A. E., AND SANDO, L. 633.8

Herbs. Their culture and uses. Parts 5, 6 and 7.

Minn. Hort., 1936, 64 : 90-1, 112-3, bibl. 22, and 131-3.

The first four parts of these series were noted in *H.A.*, 1936, 6 : 2 : 328. In part 5 short descriptions are given of some further 10 species of herbs with some general notes on harvesting, curing and storing. Part 6 is primarily concerned with the culinary uses of herbs and a few recipes, and also contains a bibliography consisting of 5 books, 6 bulletins and 11 popular articles. Part 7, which presumably concludes the series, contains a table of 88 herbs arranged by means of a key to give the following information about each :—plant family, life of plant, propagation,

* See also 629, 630, 713, 815, 885-887.

place to sow, depth to sow, spacing of plants in and between rows, suitable sites, type of soil, soil fertility and moisture, foliage and flower colour, height of plants, parts of the plant used, uses, and where the plants may be obtained.

768. HUTCHINS, A. E., AND SANDO, L. 633.8
Culinary herbs.

Circ. Univ. Minn. agric. Ext. Div., **54**, 1936, pp. 8.

The brief account of the culture, harvesting, curing and storing of herbs in general and of their culinary uses appears to be substantially the same as that noted in *H.A.*, 1932, 6 : 2 : 328 and 6 : 4 : 767. The growing and uses of 13 of the more popular herbs are described, namely sweet basil, borage, chives, garden cress, dill, fennel, horseradish, mint, parsley, sage, summer savory, winter savory, and the thymes.

769. COCHRAN, H. L. 633.841
Some factors which influence the germination of pepper seeds.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, **33** : 477-80, bibl. 3.

Under ordinary greenhouse or hotbed conditions 12 to 21 days elapse before pepper seedlings appear above the soil surface. Experiments to determine the factors responsible for this delay were made at Cornell University during the winter of 1934-35. The effect of temperature was tested in five greenhouses and was found to be marked. At 40°-50°F. no germination resulted even after 45 days, but with each successive 10° range of temperature above this the speed of germination was increased until at 90°-100°F. good germination was obtained in 5-6 days. Soaking the seed for 5 hours in tap water at 71°F. prior to planting resulted in little or no increase in speed of germination. Watering by sub-irrigation, by standing the flats in 1 inch of water until the soil surface was wet, definitely reduced the percentage germination by comparison with surface sprinkling. This decrease is thought to be due to frequent lowering of the soil temperature during and following sub-irrigation, rather than to an insufficient oxygen supply. The maximum germination from any treatment was only about 79%, which may well have been due to storage treatment prior to sowing.

770. MAZZARON, A. 633.88.34.187-1.8
 Sull' influenza di concimi diversi sulla produzione e composizione dell' essenza di timo. **(The influence of different manuring on the production and composition of thymol.)**

Ital. agric., 1936, **73** : 361-3.

An account is given of the third year's experiments on the manuring of thyme (*Thymus vulgaris*) [see *Ibidem*, 1935, 72 : 472-5, *H.A.*, 1935, 5 : 4 : 657]. The additional plant foods given were Ca, K, N, P. In the second year a great increase had been noticeable in the total crop and in the essential oil percentage from the N plot and a decrease in the essential oil percentage from the K plot. The third year's results show a deterioration in the organoleptic and chemical qualities of plants from the N plots and an improvement in these qualities from the plants off the K and P plots. The trials are being continued.

771. KNAUER, W. 635.1/7
 Gemüsebaugeographie. **(The geographical distribution of vegetable growing in Germany.)**

Forschungsdienst, 1936, **1** : 684-91, bibl. 97.

This brief account does not include research, but concerns itself entirely with the location of vegetable farming and the type of farm, whether large or small scale, and whether using glass or field cultivation. The factors influencing the incidence of vegetable growing in different districts are noted.

772. CAROLUS, R. L. 635.1/7 : 631.8
Experiences with rapid chemical tests for the determination of nutrient deficiencies in vegetable crops.

HESTER, J. B.

Interpreting rapid chemical soil tests for phosphorus for vegetable crops.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 579-83, bibl. 6, and 584-8.

[1] Fairly successful results have been obtained in testing the extracted sap of the stem and petiole portions of 19 crops for nitrate-nitrogen, phosphate-phosphorus, magnesia and potash as a means of diagnosing rapidly their nutritional deficiencies, and requirements. More limited success has attended tests for calcium oxide and ammonia. Several examples of the operation of the tests are described in this paper. In experiments with collards [a large type of kale.—Ed.] black cow peas and tomatoes it was found that, in most cases, low P availability in the soil was associated with very low phosphate-P, and very high nitrate-N, in the plant, and that, similarly, low N availability was associated with very low nitrate-N, and very high phosphate-P, in the plant during the period of rapid growth. The operation of the test for magnesia is described for cabbages growing in soils deficient in magnesium. Similarly a browning of the edges of rhubarb leaves has been correlated with potash deficiency. Manganese deficiency is apt to occur in spinach in over-limed soils, and these plants have been found to possess a very high nitrate-N content as well as reduced Mn. Tests with cucumbers and sweet potatoes are also summarized. In conclusion the author claims that these tests do not only act as an aid in diagnosing plant nutritional deficiencies, but may be of great value in nutritional research. [2] In the second paper the use of a sodium acetate solution as an extracting reagent for soil phosphates is discussed, and results obtained in the application of the soil test in fertilizer experiments with collards, peas, and lima beans are described. The author concludes with a warning that, while short chemical tests are of great help in recommending soil amendment, too much must not be expected of them, at any rate until sufficient data have been collected for their interpretation.

773. MURPHY, P. A. 633.491-2.112
Some effects of drought on potato tubers.
Emp. J. exp. Agric., 1936, 4 : 230-46, bibl. 70.

On the trial plots at Glasnevin, Ireland, after the dry summer of 1933, tubers (President) which had wilted from drought sprouted at once in October in moist sand ; hard tubers from the same plot did not do so. The sprouting tubers became hard but comparable tubers kept at a lower temperature in the same moisture conditions did not sprout and remained soft. It is shown that the yield of potatoes (Up-to-Date) is probably reduced by water loss from tubers during severe drought. Ten effects of drought on potatoes are described and some susceptible varieties are noted. The effects are :—cracking, due to resumed growth following a check by drought ; hollow heart, caused by the disappearance of starch from the central pith which subsequently breaks down—this develops under irregular irrigation or when rain follows drought ; prolongation, a form of second growth in which the tuber becomes bottle-necked, preventable by straw mulching ; gemmation, the protrusion of a single eye into a knob-like growth, this being the commonest drought effect and capable of being produced experimentally by irregular irrigation ; chain tuberization, small tubers produced in a chain on stolons—this is a bad fault ; independent tuber formation, the production of small new tubers on fresh or old stolons ; premature sprouting in the soil or afterwards ; stem-end wilt and water-loss ; glassy and jelly-end rot, attributed in Australia to leaf injury by drought to an extent that prevents the leaves from supplying all the carbohydrates wanted for new growth when the rains start ; drought heat necrosis which results in the death of the vascular ring and surrounding parenchyma mainly in the outer phloem and cortex especially at the rose- and heel-ends, or in the death of groups of cells in any part of the flesh. Some of the effects described are also produced by or accompany virus disease, and it is also noted that a number occur in association. The production of leafy shoots from half-grown tubers is connected with free formation of roots in a moist soil, and the loss of dormancy by soft tubers with starch hydrolysis after partial desiccation.

774. MINISTRY OF AGRICULTURE. 632.411 : 633.491
Potato blight.

Adv. Leaflet. Minist. Agric. Lond., 271, 1936, pp. 7.

A description of the disease is given with instructions for its control by spraying and dusting.

775. BARNES, W. C. 634.13 : 581.02
Effects of some environmental factors on growth and color of carrots.

Mem. Cornell agric. Exp. Sta., 186, 1936, pp. 36, bibl. 21.

The influence on the growth and colour of carrots of temperature, soil moisture, length of day, nutrients and age is studied, as also the interrelated influence of age of root and storage temperature on colour. The plants were grown under controlled conditions under glass. The variety used was true-breeding Chantenay. Greatest and most normal growth was obtained at 60°-70°F. Increased temperatures shortened the root, whereas decreased temperatures lengthened it in direct correlation with the decline and also proportionately increased slenderness. The alteration in shape was governed by the average rather than by the range of temperature. Low soil moisture conditions produced a smaller and more tapered carrot. Contrary to results obtained by others increase in day length did not affect the root, though it somewhat lengthened the top, except when soil moisture and temperature were least favourable to growth, when a significant increase in root weight was found. Colour was best at 60°-70°F. and decreased above and below these temperatures. The conclusion of certain other workers that colour is influenced by soil moisture is discussed, and it is argued that though this may be a contributory factor it is not the controlling one. Varying the length of day had no effect upon colour. The reason why the result is contrary to that obtained by others is discussed. In the nutrient experiments a response in type, growth, colour and chemical composition is obtained only when one of the elements is deficient. Increase in size continued for 142 days after planting and marked increase of carotene for 100 days. Carotene and vitamin A content was always higher in the larger roots. Total sugars were constant throughout the season, but there was a decrease in glucose and an increase in sucrose as the season advanced. Old carrots lost much less weight in storage than young carrots and both old and young lost much less weight at 32°F. than when stored at 50°F. The former also retained a higher percentage of sugar and original carotene. There are indications that there is some source of vitamin A in carrots in addition to carotene.

776. BEATTIE, J. H., AND BOSWELL, V. R. 581.084.2 : 635.13 + 635.25
Statistical studies of apparently uniform fields of carrots and onions on peat soils.

Gartenbauwiss., 1936, 10 : 279-88.

The authors obtained yield data on some 8,600 single row, 10 foot plots of carrots and onions on peat soil near South Bend, Indiana, in 1929, 1930 and 1931. Their data lead them to the following, among other, conclusions:—Areas of such crops planted and handled by ordinary commercial methods without careful thinning to a reasonably uniform stand, will most probably be too variable for accurate experimental work even with numerous replications. Even on highly uniform soils such methods of field work give rise to large non-correlated or random variations. Analyses of variance of yield for a few rather widely different sizes and shapes of plots calculated for areas as outlined in this paper will not only reveal the amount of variability, but will also throw much valuable light on the distribution of the variations, thereby suggesting the reasons for their occurrence. These studies emphasize the superiority of numerous replications of small plots over a smaller number of large plots in experiments where treatment of plant materials can be conveniently manipulated in small plots.

777. NEERGAARD, P. 632.4 : 635.53 + 635.13
Attacks of *Alternaria radicina* on celery and carrot.

Repr. roy. vet. agric. Coll. Yearb. for 1937, Copenhagen, Denmark, 1936, pp. 42, bibl. 27.

Alternaria radicina has been found to cause a root rot and seedling damping off in celery and carrot. The symptoms, morphology, and life cycle, etc., of the disease are described in detail.

In control experiments with infected carrot seed immersion for $\frac{1}{2}$, 1 and $1\frac{1}{2}$ hours in $\frac{1}{4}\%$ germisan, $\frac{1}{4}\%$ sanagran and $\frac{1}{4}\%$ uspulun all gave satisfactory results, whereas $\frac{1}{4}\%$ formalin, water and red copper oxide dust proved ineffective. It is not yet proved whether the fungus is of economic importance in contributing to root rotting in celery, but, should it be so, seed disinfection will probably also be of value for this crop. Other suggested control measures for both celery and carrots include :—(1) avoid planting either in soil which has just carried another umbelliferous crop ; (2) avoid storing either in places where carrots or celery have previously been stored ; (3) when planting out, all tubers of unhealthy or suspicious appearance should be discarded ; (4) spraying with bordeaux mixture and similar materials will probably help to control the disease on aerial parts of the plant.

778. BOSWELL, V. R., AND OTHERS. 635.24

Studies of the culture and certain varieties of the Jerusalem artichoke.

Tech. Bull. U.S. Dep. Agric., 514, 1936, pp. 69, bibl. 8.

The Jerusalem artichoke, *Helianthus tuberosus* L., is of importance as a crop in only a few localities in the U.S. Recent interest in it has largely centred upon its possible value as a source of raw material for the manufacture of levulose and alcohol. This bulletin reports the results of co-operative investigations carried out in five states as follows :—(1) Varietal adaptability and yield. Of 20 varieties grown in 3 states for 3 years, 3 varieties, Nos. 27574, 27095, and 27007, have proved outstandingly superior in yield and have shown a wide range of adaptability. There has in general been an unfortunate negative correlation between tuber-yielding capacity and levulose content, but despite this the highest-yielding variety, No. 27574, also showed the highest 6-year mean percentage of levulose and total sugars of the 20 varieties. (2) Size of seed piece. Net yields, i.e. total yields minus amount required for planting, from seed pieces weighing $\frac{1}{4}$, $\frac{1}{2}$, 1 and 2 oz. increased successively with each increase in size of seed pieces. The number of stalks per hill planted with a single seed piece likewise increased with the size of the seed piece. The mean size of tubers harvested, however, did not increase with the use of larger seed pieces. (3) Depth of planting. 4" and 5" planting depths, especially the former, gave slight, but consistently, better yields than did 3" or 6". Depth had no effect upon the size of the tubers harvested. (4) Times of planting. In general, both yields and tuber size were reduced with each successively later planting, and the earliest possible planting is recommended, regardless of variety or locality. (5) Spacing. In most cases 12" spacing between hills in the rows resulted in higher yields, but in significantly lower mean weight of tubers, than did wider spacings. Pending further investigations, a spacing of 2 ft. in the row is recommended for most localities. With this spacing, a distance of 3 ft. between the rows gave consistently higher yields than did greater distances except in trials in Oregon, where wider spacing both within and between rows produced no significant differences in yields. (6) Relation of time of cutting tops for silage to yield and size of tubers. The results indicate that it is very unlikely that satisfactory yields of both tops and tubers could be obtained from the same plants. Harvesting the tops just before blossoming gave the maximum green weight yield, but reduced tuber yields by 65 to 75%. Harvesting the tops just after blossoming gave the maximum dry matter yields, but reduced tuber yields by 40 to 60%, while delaying harvesting after this period resulted in great losses of both green and dry matter. (7) Volunteer plants arising after tuber harvest could not be controlled efficiently by cutting off the sprouts, but deep and thorough ploughing in the late spring or early summer proved to be effective, particularly when followed by a quick-growing hay crop. Any survivors should subsequently be hand pulled before tuber formation in August.

779. BOSWELL, V. R. 635.24

Growing the Jerusalem artichoke.

Leaflet. U.S. Dep. Agric., 116, 1936, pp. 8.

Much of the information given in this leaflet is based on the results of co-operative investigations carried out in several states which are reviewed above in abstract 778. Recommendations regarding choice of varieties, time of planting, size of tubers, spacing, depth of planting, time of

harvesting and eradication of volunteer plants are based on those results. In addition a tentative suggestion is made to use a 4-8-4, a 4-12-4 or equivalent fertilizer mixture, and to cultivate not more deeply than $1\frac{1}{2}$ to 2 inches so as to avoid damaging stolons and tubers. Notes are also supplied on methods of harvesting, storing and handling, and on the yield of tubers.

780. BREMER, H. 635.25
 Ueber Zwiebelbildung und -abreifung bei der Küchenzwiebel. (**Bulb formation and ripening in the onion.**)
Angew. Bot., 1936, 18 : 204-31, bibl. 18.

The author summarizes these experiments made partly under glass in pots and partly in the field as follows:—onion formation took place only in the presence of a minimum supply of assimilates and is dependent on the relation of carbohydrate assimilation to the intake of salts. It is fundamentally immaterial whether the "swelling" value of the assimilates is achieved by strong photosynthesis or by scanty intake of minerals. In glasshouse experiments it was shown that relative onion formation is helped by nitrogen deficiency in conjunction with excess of potassium and is checked by potassium deficiency in conjunction with excess of nitrogen. In the field it was possible to show increased onion formation due to lack of nitrogen. In our climate [Aschersleben, North Germany.—Ed.] greater room results in restriction of onion bulb formation due to the relative superiority of increased nutrient intake over increased photosynthesis, both resulting from increased spacing. As regards the known dependence of onion formation on long daylight the second half of the growing period is the decisive stage. Delayed sowing results in restricted bulb formation. Potassium deficiency had a very deleterious effect on bulb formation in a glasshouse experiment carried out in the short day winter months. The breaking off of the leaves, which after the conclusion of bulb formation introduces the ripening process, is hindered by those factors which tend to give the leaves a strong, xeromorphic structure, such as strong light, nitrogen deficiency and excess of potassium. It is on the contrary hastened by factors which impart to the leaf a soft hygromorphic form, such as shaded growth, excess nitrogen and potassium deficiency.

781. HAWTHORN, L. R. 635.25 : 631.8
 Fertilizer experiments with Yellow Bermuda onions in the Winter Garden region of Texas.
Bull. Tex. agric. Exp. Sta., 524, 1936, pp. 35, bibl. 14.

The soil used in these experiments was a fine, sandy loam, containing abundant potash (K) but low in nitrogen (N) and phosphoric acid (P). Trials covering four years indicate that P gave the greatest increases in yields, N gave some further increase when P was also applied, but K had no appreciable effect, tending, if anything, to decrease yields after the first year. N (in the form of ammonium sulphate) applied alone was ineffective, and sometimes even depressed yields, but P (20% superphosphate) used alone at a rate of 360 lb. per acre usually gave profitable increases. N and P, combined to make an application equivalent to 600 lb. 6-12-0 fertilizer, usually gave a greater increase in yield than P alone, and dressings of 600 to 900 lb. of this mixture are recommended for general purposes. On previously unfertilized land 1,200 lb., including perhaps some K, may be used in the first year. The application of all the fertilizer before transplanting has been shown to be more effective and economical than subsequent top-dressings of any kind. In fact N applied as a top-dressing may decrease rather than increase yields. Among N fertilizers cyanamide has consistently resulted in lower yields than have nitrate of soda, sulphate of ammonia or cottonseed meal, when combined with P and K. In general, onions receiving adequate amounts of a 6-12-0 fertilizer were anything up to 10 days earlier than similar unmanured onions, and, in addition, particularly in response to P, gave a higher proportion of U.S. No. 1 bulbs. Excessive N resulted in greater liability to decay in stored onions. Satisfactory manuring has been usually found to reduce damage by thrips, *Thrips tabaci*, to a point at which a profitable crop may be expected, but has proved unsuccessful in counteracting crop reductions due to pink root disease, *Fusarium mali*.

782. KNOTT, J. E. 635.25 : 631.8

Fertilizing onions on muck soils.

Bull. Cornell agric. Exp. Sta., 650, 1936, pp. 20, bibl. 20.

The term "muck" is used by growers to denote a peat soil. The present paper reports the results of fertilizer experiments covering a period of five years and carried out in several localities. The number of years in which the various plots had previously been cultivated ranged from 3 to 56. Recommendations based on the experimental results are as follows:—When onions are grown on recently cleared mucks, which have previously supported timber, no nitrogen is required and a dressing of 1 ton of 0-10-10 mixture or its equivalent is suggested. Where the new muck has previously supported reeds and sedges, some nitrogen is needed, and a dressing of 3-12-18 at 1,000 lb. per acre is suggested. On muck soils which have been fertilized well for 10 or more years and have not been flooded, 1,000 to 1,200 lb. 5-8-7 fertilizer should be adequate, but where flooding has occurred 1,200 to 1,500 lb. 4-8-12 mixture is recommended. On old muck soils a top-dressing of 150-200 lb. nitrate of soda or sulphate of ammonia is often beneficial when the plants are 3 to 5 inches high, especially in cool, wet seasons. Where the onions produced have thin, poorly coloured scales, and their tops die prematurely, an application of 300 lb. finely ground copper sulphate per acre is advocated.

783. DEARBORN, C. H., AND RALEIGH, G. J. 635.35 : 632.19 : 546.27

A preliminary note on the control of internal browning of cauliflower by the use of boron.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 622-3.

A browning of the curd of cauliflower has for several years past caused severe losses to growers in parts of New York State. Fertilizer experiments with 6 minor elements applied alone and supplementary to regular fertilizers were carried out in 1935 in 24 fields, representing all the important soil types in the area. No surface browning developed in any of the 24 plots receiving boron, and very slight internal browning developed in only two of these plots, whereas both forms of browning occurred in all the plots receiving treatments excluding boron. These studies are being continued to determine if this effect will be repeated.

784. KNOTT, J. E. 635.52

Quality of lettuce as it affects the New York lettuce industry.

Bull. Cornell agric. Exp. Sta., 651, 1936, pp. 17, bibl. 5.

The definite depression in prices received by growers who pack lettuce badly compared with those who pack it well is shown as a result of extensive investigations in field and market. Bad packing consists of the inclusion in the pack, either mixed with sound lettuce or alone, of lettuce showing the following defects:—softness, discoloured outer leaves, tip burn, incipient seed-stems, decay of various kinds especially bottom rot. Experienced buyers can detect the presence of inferior lettuce by the weight of the boxes when handled. The inclusion of but two or three immature or soft heads in an otherwise good pack makes a detectable difference to the weight. The economic and other reasons which are the cause of bad packing are discussed and recommendations are made whereby the standard can be improved.

785. THOMPSON, R. C. 635.52 : 631.531

Some factors associated with dormancy of lettuce seed.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 610-6, bibl. 6.

The results of tests made with Grand Rapids, a variety known to produce seed which frequently will not germinate for some time after harvest, and with Iceberg, a variety known generally to exhibit little dormancy in freshly harvested seed, have suggested that immaturity at the time of harvest is an important factor contributing to dormancy and light sensitivity in lettuce seed. There was a marked difference in the response of the two varieties to light and temperature.

Mature seed of both germinated well 2 weeks after harvest in diffused light at 15°-20°C. and in the dark at 10°-15°C., but, whereas Iceberg seed also germinated well in the dark at 25°C., Grand Rapids seed germinated poorly at this temperature. Differences in response to light were particularly striking in samples of immature seed. Grand Rapids seed germinated comparatively well in light, but very poorly in darkness at either low or high temperature, whereas Iceberg seed germinated fairly well in either light or darkness. Where rapid germination is required for seed of varieties known to be difficult to germinate in darkness for some time after harvest it is suggested that thrashing be done immediately after harvest so that only mature seed is included. In other experiments with these varieties and Hubbard's Market a correlation was found between the amount of seed produced and the extent of dormancy, which suggests that dormancy may, to some extent, be a question of nutrition. This aspect of the problem is now being studied.

786. BEWLEY, W. F. 635.52 + 631.544.2

Experimental results of 1935. 3. Lettuce. 4. Cold frames.

Annu. Rep. Res. Sta. Cheshunt for 1935, 1936, 21 : 33-6.

Trials of Cheshunt Early Giant lettuce planted on different dates have shown the usefulness of this variety for autumn and winter work. The best lettuce was cut at the end of October and early November from plants set out in mid-September, and during February and March from plants set out in early December. This variety is essentially a short day type and may bolt if planted prior to mid-September. In cold frames applications of sphagnum peat and spent mushroom manure improved the physical state of the soil, and lettuce planted in February grew more rapidly and produced larger and better heads than that in control frames. Applications of "bacterized" peat delayed hearting by about 10 days, but produced lettuce with even larger heads than the other two treatments. Soil heating experiments were continued and the results indicated that soil temperatures above 65°F. are too high for spring lettuce in frames, the hearts showing a tendency to open and bolt.

787. BEWLEY, W. F. 635.63

Experimental results of 1935. 2. Cucumbers.

Annu. Rep. Res. Sta. Cheshunt for 1935, 1936, 21 : 27 and 30-3.

Soil heating :—The maintenance of a constant bed temperature of 88° to 90°F. in 1935 resulted in a crop increase of 27.4% over controls. These results confirm those obtained prior to 1934, in which year soil heating gave no response, owing probably to the season being unusually warm and suitable for cucumbers. *Electric light in propagating houses* :—Submitting young cucumber plants to 5 hours' additional light at the end of each natural day from the time of sowing the seed to the time when the plants left the propagating house has given promising results in the 1935 season, which was one of bad natural light conditions. Plants under two types of neon tubes were of better form and slightly more robust than those submitted to light from 500 watt electric bulbs. Picking on the irradiated plants began 10 days sooner than on the controls, but there was no difference in final total yields. *Hybridization* :—F1 and F2 generations of a cross between Butcher's Disease Resister and Delicacy were grown and selections made.

788. NORFOLK COUNTY COUNCIL. 631.544

Experiments with glasshouse crops.

Annu. Rep. hort. Superintendent, Norfolk C.C., for 1935, pp. 30-42.

Stopping tomato plants :—Experiments carried out in growers' houses gave in two instances no significant differences in yield between stopped and unstopped plants. The third grower obtained heavier and more vigorous growth and a greater freedom from virus disease with unstopped plants. There is a considerable saving of labour in leaving plants unstopped.

Heating :—A tomato house in which heat was maintained until October gave a more than 10% increase of yield with less mildew, over a house in which the heat was turned off on June 28th. The experiments are being continued.

789. BEWLEY, W. F.

635.64

Experimental results of 1935. 1. Tomatoes.

Annu. Rep. Res. Sta. Cheshunt for 1935, 1936, 21 : 17-27 and 28-9.

Fertilizer experiment :—The addition of nitrogen as 4 or 8 oz. hoof and horn per square yard after steam sterilizing but before planting has proved without effect during a sunny summer, and during dull summers might lead to excessive leaf development. The addition of phosphate as 4 oz. bone meal has had no effect and is regarded as unnecessary. *Experiments on the adding of wheat straw to glasshouse soils* :—Trials in one house indicate a beneficial effect on yield of straw added in the previous year during steam sterilizing. In another house the results show a better response from steam sterilizing than from applications of straw. Similar trials by growers suggest that straw is generally beneficial on heavy soils previously well manured, but that it cannot be recommended for poor, light soils. **Variety trials** :—Yields and quality grades from new varieties, including some new crosses of F2 generation, are tabulated. *The use of peat as a surface rooting medium* :—A dressing of sphagnum peat was applied to the soil to form a layer 1½ inches thick in houses where tomatoes were wilting through the agency of common root rot in a fairly advanced condition, and where the plants were badly attacked by eelworm. The results were very beneficial and in both cases new root growth rapidly developed in the peat, and satisfactory crops were obtained. **"Stopping" experiment** :—Stopping the plants at the 5th truss and then allowing all shoots to develop resulted in a distinctly lower yield than stopping the plants at the 5th truss and then pruning to one stem, or than not stopping the plants. **Soil heating** :—Experiences with soil heating in relation to *Verticillium* wilt are recorded.

790. SMITH, O.

635.64 : 581.162.3

Pollination and life history studies of the tomato (*Lycopersicon esculentum* Mill.)

Mem. Cornell agric. Exp. Sta., 184, 1936, pp. 16, bibl. 24.

The paper consists of morphological and pollination studies of the tomato flowers and fruit undertaken to assist the attempt now being made to understand and remedy the excessive blossom drop and poor set of fruit which occur under certain environmental conditions in U.S.A. There are 23 plates, containing in all 100 figures, to illustrate the studies.

791. SMITH, O.

635.64 : 612.014.44

Effects of light on carotenoid formation in tomato fruits.

Mem. Cornell agric. Exp. Sta., 187, 1936, pp. 26, bibl. 23.

Light has an important bearing on the formation of carotenoid pigments in plants and of these pigments carotene is a precursor of vitamin A. Carotenoid content of greenhouse tomatoes is less than that in the same variety grown out of doors. Varieties grown in the dark had a lower carotenoid content in skin and flesh than when grown in the light. A high percentage of light quality, with wavelengths approximating 5,400-5,800 A.U., is not conducive to maximum production, whereas some longer and shorter wavelengths appear to increase the carotenoid content of the fruits. Identical treatments in winter and summer resulted in the carotenoid content of the skin in each treatment being higher in the winter than in the summer series, but the contrary obtained in the flesh. Maximum carotenoid content is obtained when the fruits are grown in full light and allowed to mature on the plant. A possible transfer of carotenoids or carotenoid-forming substance from the plant to the fruit is indicated. Lycopene, an isomer of carotene, but not a precursor of vitamin A, is favoured by protection from intense light, whereas carotene is produced at the maximum in full light. That lycopene cannot be an oxidation product of chlorophyll is shown by its production in fruits which have been grown in

complete darkness and have never contained chlorophyll. Plastids of mature-green fruits are smaller and fewer in fruits grown in the dark than in fruits grown in normal light. Lycopene was not found in plastids but carotene was found in granular form, both inside plastids and after their decomposition. Crystalline and globular forms of carotene also occur.

792. GOODALL, D. W. 635.64 : 581.14

A note on variation in growth rate in the tomato seedling.

Annu. Rep. Res. Sta. Cheshunt for 1935, 1936, 21 : 84-6, bibl. 1.

Tomato plants vary considerably in size by the time the first flower truss begins to develop, and attempts to determine the causes of this variation are summarized in this paper. In measurements made at regular intervals over a period of five weeks the rate of increase in leaf length of the first six leaves was used as a measure of growth rate. The values obtained in a cool house showed great variation, which was only slightly reduced when the positions of the pots were constantly changed, so that each might pass through the whole range of environmental conditions present. In addition no significant correlation was obtained between the time taken for a given amount of water to drain away when added to already saturated soil in the pots and the rate of growth. A highly significant positive correlation was, however, obtained between leaf water content and growth rate. The results indicate that in November and December the optimal water content for leaf growth exceeds 92.23%, and from a correlation diagram it appears to be not less than 93%. It is recalled that elsewhere the optimum water content for assimilation per unit leaf area was established as only 92%, but the significance of the difference between these figures has not yet been determined.

793. PORTER, A. M. 635.64

Retarding effect of hardening on yield and earliness of tomatoes.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 542-4, bibl. 1.

In an experiment with an early, a mid-season and two late varieties of tomato half the plants were kept in a greenhouse up to the date at which they were planted out in the field, and the other half were placed in cold frames to harden for 10 days before planting out. Data obtained in two years indicate that, although hardening increases the total seasonal yield, it reduces the early yield of marketable fruits regardless of variety, and does not result in increased profits over those obtained from tender plants. It is also pointed out that a higher proportion of the crop from non-hardened plants is harvested before late blight or other serious diseases ruin the crop late in the season.

794. SCHLÖSSER, L. A. 632.111 : 576.312.35

Frosthärte und Polyploidie. (Cold resistance and polyploidy.)

Züchter, 1936, 8 : 75-80, bibl. 6.

Experiments made with wild tomato forms, *Lycopersicum racemigerum* and *L. cerasiforme* and with winter rape.

795. FRAZIER, W. A. 635.64-2.19

Further studies on the occurrence of cracks in tomato fruits.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 536-41, bibl. 6.

The pruning of tomato plants of three varieties to a single stem resulted in each case in an increased occurrence of both concentric and radial cracking. The removal of two-thirds of the leaves of the pruned plants produced a decided decrease in cracking as compared with pruned, non-defoliated plants. Heavy fertilizing with N, P and K had no appreciable effect on the cracking of fruits of the Marglobe variety. The conclusion is drawn that, although recent studies point to water absorption by the fruit from inside or outside the plant as the principal cause of fruit cracking, yet the effects of pruning noted above and the results obtained in previous experiments* indicate that there are other factors, so far unexplained, which may also greatly influence cracking.

* *Ibidem for 1934, 1935, 32 : 519-23, H.A., 1935, 5 : 3 : 420.*

796. CHILDERS, N. F. 635.64 : 632.95

Some effects of sprays on the growth and transpiration of tomatoes.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 532-5, bibl. 6.

Data from field experiments indicate that the application of bordeaux mixture to tomato plants growing under drought conditions caused a marked reduction in plant growth, yield and individual fruit size, whereas heavy and light oil sprays had little apparent effect upon total yield and size of fruit, but caused an increase in plant growth. In greenhouse experiments with mature tomato plants bordeaux mixture had practically no effect upon the total amount of water transpired over a 10 day period under either low or high transpiration conditions, whereas heavy oil caused a marked reduction in transpiration. Several other sprays had less effect, but also tended, if anything, to reduce transpiration. In view of results obtained elsewhere it is thought that the younger leaves on the plants sprayed with bordeaux had an increased rate of transpiration, but that a possible clogging effect of the spray sediment on mature leaves counterbalanced this effect. It is recommended, therefore, that spraying with bordeaux be avoided, where possible, during dry seasons, and that, if it is unavoidable, as little as possible of the spray should be applied to young growing portions of the plant.

797. BOLAS, B. D., AND SELMAN, I. W. 635.64 : 581.13

The movement of assimilate in seedling tomato plants.

Annu. Rep. Res. Sta. Cheshunt for 1935, 1936, 21 : 82-4.

Determinations made in July and January indicate that the ratio of the dry weights of the various parts of a seedling tomato plant varies according to the time of year at which the plant is grown. There was also found to be little change in the ratio of the weight of the plant parts between the beginning and end of the daily assimilation period, and from this it is inferred that the greater part of the movement of assimilate out of the leaves into the stem and root occurs during the assimilation period and not, as has often been thought, during the nights. The results further suggest that the respiration rate of the root is disproportionately high in winter.

798. HIRST, F., AND ADAM, W. B. 635.656

Green pea varieties. Results of canning trials 1925-35.

Annu. Rep. Fruit Veg. Pres. Sta., Campton, for 1934-35, 1936, pp. 29-43, bibl. 5.

The object of this article is to collect and summarize the results of 11 years' work on the suitability of the chief commercial varieties of peas for canning. After a brief introductory account of the more important characteristics of peas, the main varieties are tabulated so as to show at a glance their distinguishing characteristics both from a horticultural and from a canning standpoint. The information is tabulated under the following headings :—Variety names, including synonyms, and season of cropping ; seed colour and shape ; haulm colour and length ; pod length, shape and number of peas ; the colour, shape, size and flavour of the peas ; and the canning properties of the peas. The approximate numbers of varieties described are :—First early varieties 10, second early 15, early main crop 7, and main crop 20.

799. SIDDAPPA, G. S., AND ADAM, W. B. 635.656 : 631.547.6

The ripening of green peas.

Annu. Rep. Fruit Veg. Pres. Sta., Campton, for 1934-35, 1936, pp. 74-100, bibl. 6.

The paper reports data obtained from a biochemical investigation carried out during four successive years on six of the more important varieties of canning pea, namely Alaska, Gregory's Surprise, Thomas Laxton, Lincoln, Cannors' Perfection and Charles the First. Analyses were made at intervals of 2 to 4 days during the main period of ripening. The results are presented

and discussed in detail. Alaska, a round seeded variety, was found to possess a higher starch-sugar ratio and relatively poorer quality than the other five varieties, which were all wrinkle-seeded. In all four years the ripening process developed in two distinct stages. An early period, which normally ended 2-3 days after the "canning stage" had been reached, was characterized by fairly constant starch and sugar contents as the peas increased in size. Total solids and insoluble solids, other than starch, increased from the smaller to the larger grades, but there was rather less sugar in the large and small grades than in the medium sizes. The percentages of protein nitrogen and of mineral constituents in the solid matter remained almost constant. A second, and rapid, period of ripening followed, and was characterized by a sudden increase in starch and the higher carbohydrates, and a decrease in sugar. Throughout the whole of the main ripening period there was a fairly constant ratio of reducing sugars to total sugars. During the first ripening period the peas were all of high quality, but during the second stage there was a pronounced deterioration in quality. The time elapsing between the "canning date" and the commencement of the final, rapid, ripening stage was roughly the same in each season and with each variety, namely 2-3 days. It was found, however, that the crop of pods might continue to increase in weight for 7-10 days after the "canning stage". With the exception of starch contents, the development and ripening of the crop showed a general similarity in the different seasons. At the "canning stage" the proportion of peas to pods was approximately the same for any one variety from year to year. The distribution of sizes of the peas was also fairly constant at this stage, although two varieties, Lincoln and Thomas Laxton, were slightly larger in the relatively cool season of 1932. The rate at which the pods developed did not vary greatly in the four years. Starch contents of the different sizes of each variety when estimated at the "canning stage" were, however, much lower in a cool than in a hot summer.

800. SAYRE, C. B., AND CUMINGS, G. A. 635.656 : 631.8

Fertilizer placement for cannery peas.

Bull. N.Y. St. agric. Exp. Sta., 659, 1936, pp. 30, bibl. 8.

Trials covering 3 years have shown that the drilling of pea seed and fertilizers in one operation, so that the seed and fertilizer are in contact, produces injurious results and reduces yield by comparison with unfertilized plots, even when heavy rain falls shortly after sowing. Superphosphate alone proved less injurious than a "complete" 4-16-4 fertilizer. The injurious effect and reduction in yield was still apparent, but less pronounced, when the fertilizer was distributed above the seed, but little injury occurred when the fertilizer and seed were sown in separate operations. Separate placement of seed and fertilizer is not possible with the drills commonly used in New York, and an attachment to a grain drill has, therefore, been devised and is described, whereby this difficulty may be overcome. One year's experiments with this attachment are discussed with the warning that the results obtained should be regarded as in the nature of a progress report and not as conclusive. The best results were obtained by placing the fertilizer $2\frac{1}{2}$ inches to the side and 1 inch below the seed. When a spacing of $2\frac{1}{2}$ inches was used, no reduction in germination nor injury to the plants resulted from increased quantities of fertilizer. A more economical increase in yield was obtained from the use of superphosphate alone than from the use of an equal amount of phosphoric acid in a 4-16-4 mixed fertilizer, and it is recommended that peas should be fertilized with 300 to 600 lb. of 16% superphosphate or of a 4-16-4 mixture placed at sowing time as advised above. The application of this fertilizer apparently prevents any inequality in the maturing of cannery peas, which might result from residual manurial effects from the preceding crop.

801. LUDEWIG, K., AND VOSS, J. 635.65 + 633.367

Morphologische Sortenstudien an Erbsen, Ackerbohnen und Lupinen.

(Morphological varietal studies on peas, field bean and lupins.)

Angew. Bot., 1936, 18 : 263-337, bibl. 21.

After describing the normal development of peas, field beans and lupins and the more noticeable characters which facilitate differentiation between different varieties, the authors note the

characteristics of 56 varieties of pea as regards seed, flowering time, flower, stalk and leaf, and seedling. Further they classify them according to time of flowering and height attained. Of field beans 39 varieties are dealt with on much the same lines and finally 11 yellow flowered, 14 blue flowered, 3 red flowered and 4 white flowered lupins are classified rather more briefly.

802. STAPP, C., AND HÄHNE, H. 632.314 : 635.652
 Zur Frage der Resistenz von Buschbohnsensorten gegen den Erreger der
 Fettfleckenkrankheit *Pseudomonas medicaginis* var. *phaseolicola* Burkh.
 (The resistance of dwarf beans to *P. medicaginis* var. *phaseolicola*.)
Angew. Bot., 1936, 18 : 249-62, bibl. 7.

Fifty-six varieties of dwarf bean from 360 sources were tested in the greenhouse at Dahlem and the same number of varieties from 476 sources in the field at Aschersleben and their behaviour towards *Pseudomonas medicaginis* var. *phaseolicola* observed under both conditions. Out of 320 trials of susceptible varieties at least 20% came from infected seed stock. Individual varieties varied in susceptibility both in the greenhouse and in the open according to the source (which would appear to indicate lack of trueness in varietal nomenclature). Certain varieties proved more susceptible in the greenhouse than in the open. On the other hand a number of varieties which had shown good resistance in the greenhouse in 1935 proved definitely susceptible in the field. Both this phenomenon and the possibility of location affecting susceptibility need further investigation.

803. ARNOLD, E. L., AND HORSFALL, J. G. 635.656 : 631.531
 Use of graphite to prevent clogging of drills when sowing dusted pea seed.
Bull. N.Y. St. agric. Exp. Sta., 660, 1936, pp. 23, bibl. in text.

The treatment of pea (*Pisum sativum* L.) seeds, prior to drilling, with 2½ oz. of the dust fungicide, red copper oxide, has been found to result in the clogging and breaking of grain drills of the internal force-feed type. Investigation showed that the trouble was not due to the accumulation of copper oxide in the mechanism of the drill, but that it resulted largely, if not entirely, from increased interfacial friction between the seeds and between the seeds and the feeding mechanism. Using an "index of friction", estimated from the number of turns necessary to pass a uniform lot of seed through a standard drill cup, it was found that the interfacial friction increased with the dosage of chemical, with the number of revolutions of the mixer, with the time taken in mixing and with the moisture content of the seed, but not with the storage conditions of the chemical. The lubrication of treated seed with water at the time of sowing reduced friction effectively, but the method is inconvenient and seeds once sprinkled must be drilled immediately. Flaked graphite pulverized to pass a 325-mesh screen, when added at the time of treatment, also lubricated the seed, but without the disadvantages associated with water. The amount of graphite necessary to reduce the friction to normal was approximately one-half as much by weight as the copper oxide, and the recommended quantity is 1½ oz. per bushel. Mica, talc and carbon black proved useless as lubricants. Tests with Semesan-treated cabbage seed and copper carbonate- and red copper oxide-treated wheat seed confirm that graphite will also reduce friction in these cases.

804. DIMMOCK, F. 635.655
 Seed mottling in soybeans.
Sci. Agric., 1936, 17 : 42-9, bibl. 5.

Mottling is an abnormal blotching with brown or black markings of the seed coat of yellow- and green-seeded varieties of soybeans. The occurrence is sporadic. Certain abnormal plants invariably produce mottled seed, but many apparently normal plants do also. The effect of many mottled seeds in a sample is to give an impression of impurity of strain to those unfamiliar with its occurrence. In this paper environment and heredity are shown to have a definite influence on mottling. All varieties tested showed susceptibility to mottling. Selection of resistant strains and breeding appear to be possible methods of control.

805. BURK, E. F. 631.544.3 : 631.588.1

Synthetic manure-heated hotbeds.

STOUT, G. J., AND OTHERS.

Experiments on electric, coal, gas, kerosene and manure-heated hotbeds.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 603-4, bibl. 1, and 605-9.

[1] Hotbeds made by adding 7 lb. calcium cyanamide to 100 lb. cotton burrs gave a higher temperature than the commonly used heating agent, horse manure. Prairie hay +CaCN₂ gave results approximately equal to horse manure, but similarly treated Bermuda grass and straw yielded less heat.

[2] The results of trials with hotbeds heated by four electrical methods, and by manure, anthracite coal, kerosene and gas, are briefly summarized. The fuel used per sash per month is calculated.

806. WHITCOMB, W. D. 632.944 : 547.652.1 : 631.544

Naphthalene as a greenhouse fumigant.

Bull. Mass. agric. Exp. Sta., 326, 1935, pp. 31, bibl. 21.

The author writes, "This bulletin is intended to supply specific information regarding the conditions under which greenhouse fumigation with naphthalene is both safe and effective." Experiments on the control of red spider in particular are discussed. Naphthalene is effective, though in different degrees, against all stages of red spider, and the most satisfactory dosage is 2 to 3 oz. per 1,000 cubic feet for a total exposure of 6 hours. Under favourable conditions two successive fumigations have given almost perfect control, but frequently 3 or 4 treatments within 10 to 15 days are necessary. A two-wick coal-oil stove is the most practical vaporizer under average glasshouse conditions. Fumigation done in direct sunlight has no detrimental effects on plants which are tolerant to naphthalene and which are well hardened-off, but with plants susceptible to injury or which are soft, following forced growth, fumigation should be done only on cloudy days or at night. Suitable temperatures lie between 75° and 85°F. At about 72°F. recrystallization occurs and at 95°F. and higher the plants are affected adversely. Experiments are described which indicate that a relative humidity of 75 to 80% is desirable, if fumigation is to be fully effective. A trial, in which naphthalene was combined with para-dichlorobenzene in the proportion 85 to 15 with a view to reducing the recrystallization temperature, did not prove this combination to be significantly superior to naphthalene alone. In addition to red spider, several thrips, aphides, white fly and mealy bugs are controlled in greater or less degree by naphthalene. A list of plants susceptible and resistant to fumigation injury is given. Of the commoner glasshouse crops begonia (Chatelaine type), carnation and cyclamen are very tolerant, while tomato, geranium, lilies and some roses are usually injured. Cucumbers are less damaged than tomatoes, but with both these crops fumigation while the fruit is ripening results in the flavour of naphthalene being retained by the fruit for some days. With certain varieties of chrysanthemums fumigation during the period of bud development may result in blindness. Finally costs of fumigation with naphthalene are given.

FLOWER GROWING.

807. GRIFFITHS, D. 635.944

Tulips.

Circ. U.S. Dep. Agr., 372, 1936, pp. 63, bibl. 14.

This interesting and comprehensive paper is addressed primarily to the grower of tulip bulbs and contains information on the following points:—The structure and development of the tulip plant and bulb; categories of bulbs and sizes of flowering bulbs; the classification of tulips based on the arrangement devised by the Royal Horticultural Society (London), and notes on suitable varieties to grow; the climatic range adapted to tulip species and the winter hardiness of the bulbs; soils and manuring; planting, cultivation, roguing, the removal of flowers, and lifting the bulbs; handling, curing, storage and yield; packing and shipping the bulbs. Sections

are also devoted to the implements and tools used and to the labour required, and notes are supplied on the production of tulips for beds and borders, the naturalizing of tulips, forcing tulips, breeding new varieties, and diseases, pests and abnormalities.

808. LONGLEY, L. E. 635.944 : 632.8

Flower color in "broken" or mosaic tulips.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 674-7, bibl. 9.

A few points concerning the pigmentation of the tulip flower in relation to the manifestation of "breaking" are discussed. Some 80 varieties were inoculated, and 39 have been found to show definite infection by the mosaic virus. These are listed in groups based on the colour classification described.

809. GRIFFITHS, D. 635.944 : 631.544

Speeding up flowering in the daffodil and the bulbous iris.

Circ. U.S. Dep. Agric., 367, 1936, pp. 18.

The effect of storage temperatures upon the flowering of daffodil and iris stocks has been studied over a period of about 7 years, and in this paper only the more important and more interesting results obtained are described. Reduced temperatures throughout the storage season for daffodil bulbs produce decided acceleration of flowering, but if too low result in detrimental dwarfing. In the early trumpet varieties, for instance, storage at 36°F. virtually inhibited growth after planting. With higher temperatures dwarfing became proportionally less marked and flowering gradually later, until the most satisfactory balance was attained at about 50°F. It was then discovered that a similar response could be obtained when cool temperatures were used during only the last month of storage and the recommended procedure is to employ common warm storage until August 1 and then keep the bulbs at a constant temperature of 50°F. until they are potted about one month later, when flowering will be accelerated by 3-4 weeks without any detrimental dwarfing. During the period of warm storage it is advisable not to let the temperature fall below 70°F. for any considerable period. With low temperature treatment the time needed to bring daffodil bulbs into flower is reduced from 4-5 months to 3-4 months if potting is done early, to 2 months if potting is done in mid-season, and to 1 month if done late in the season. Where daffodils are potted early it is imperative to allow 8-12 weeks for the development of a copious root system, but as the potting season is advanced the time for rooting may be progressively curtailed. In the case where bulbs required for late forcing are potted after 1 December, the best storage temperatures are 40° to 55°F. up to planting time. Other means of accelerating flowering include digging the bulbs some 2-3 weeks early, when they will be less firm but will produce satisfactory flowers, and the growing of bulbs for one year in warmer northern areas where they are ready to be lifted earlier. The reaction of Dutch and Spanish iris bulbs to a temperature of 50°F. during August is essentially the same as that of daffodils. When planted in early September, however, they should be placed direct on greenhouse benches for rooting instead of being kept in a cool situation. It is also beneficial to apply a preliminary heat treatment of about 80°F. between digging and the commencement of reduced temperature treatment in August. The variety Wedgewood has, on the whole, reacted the most readily to cool storage treatment, and its flowering has been accelerated from 4-6 weeks without detrimental dwarfing.

810. WAUGH, F. A. 635.937.9

The bulbous iris and its outdoor culture in Massachusetts.

Bull. Mass. agric. Exp. Sta., 330, 1936, pp. 15.

The greater part of this paper is taken up with tabulated descriptions of varieties of bulbous irises, which are divided into four groups:—Spanish, English and Dutch irises and varieties of *Iris tingiana*. A short account is given of their cultivation in gardens, which closely resembles that of the common hardy tulips. Among the points of particular interest it is recorded that,

contrary to popular opinion, the bulbous irises have been found very resistant to winter injury. So far as could be ascertained not a single bulb was lost at Massachusetts State College as a result of the record cold winter of 1933-34. The bulbous irises are also suitable for winter forcing under glass.

811. PARKER, M. M. 635.944 : 631.8

The effect of fertilizers on the yield of narcissus bulbs.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 678-82, bibl. 2.

The effects of a 2-10-5 fertilizer mixture at 1,000 lb. per acre alone and plus a 9-8-3 spring top-dressing of 500 lb. per acre were tested on narcissus bulbs growing in a relatively infertile fine sandy loam soil of pH 5.0 to pH 5.4. The results indicate that there was no appreciable increase in the loss of bulbs in the field or in storage which could be attributed to manuring. There were also no significant differences in the number or size of blooms between manured and unmanured plots. The addition of fertilizers produced marked increases, however, in the number and weight of mother bulbs formed, particularly in the plots receiving the top-dressing in the spring and where small, as opposed to large, planting stock was used. The increase in the number of mother bulbs naturally resulted in a decrease in the number of round bulbs in the fertilized plots, but the total weight of bulbs was still much greater where the top-dressing was applied and where the small planting stocks were used. The author concludes that the use of fertilizers would appear to be justified where planting is done primarily for propagation purposes, but not where the bulbs are grown for the production of cut flowers.

812. BARTON, L. V. 635.936.751

Germination of delphinium seeds.

Contr. Boyce Thompson Inst., 1935, 7 : 405-9.

Seeds of annual delphinium germinate very poorly at temperatures exceeding 20°C. The study described here was undertaken to discover if the seeds could be induced to germinate at high temperatures after pre-treatment at low temperatures. It was found that, if the seeds were kept in a moist environment, as on damp filter paper in petri dishes, for a period of 1, 2 or 3 weeks in an ordinary cool storage room at temperatures of 10° to 15°C. or in a refrigerator at 5° to 10°C., they would subsequently germinate satisfactorily at constant temperatures of 20° to 30°C., or in a glasshouse with a temperature range of 21° to 43°C. Pre-treatment temperatures of 1° to 5°C. proved distinctly less effective than the somewhat higher temperatures mentioned above. Perennial delphiniums are much less sensitive to high germination temperatures, and tests similar to those made on the annual forms indicated no advantage from pre-treatment where the seeds were sown under ordinary hot or cool glasshouse conditions. Only when a germination temperature of 35°C. was maintained did pre-treatment produce a distinct response.

813. WHITE, H. E. 635.936.751

Some studies on the forcing of delphinium.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 653-4.

1-year-old plants of *Delphinium Belladonna*, which had not previously flowered, were forced into bloom under glass during November and December by storing them for 8 weeks during July and August at temperatures of 34° to 36°F. 4 weeks' cold storage proved less satisfactory than 8, and temperatures of 32° to 34°F. than slightly higher temperatures.

814. FARNHAM, R. B. 635.937.36

Factors associated with bud-drop of sweet peas and methods of control.

SMITH, J. E.

Abscission of sweet pea flower buds.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 655-62, bibl. 2, and 663-8, bibl. 10.

[1] The dropping of buds from the flower stems of sweet peas during short, dark winter days is a cause of serious economic loss to florists. The study reported here was undertaken to determine the effect of nutrient salt concentrations upon the growth of the plants, bud-drop, and the

formation of relatively higher carbohydrate reserves. The plants were grown in sand and received Shive's " R_2S_4 " solution at $\frac{1}{2}$, 1, 2 and 3 atmospheres concentration, the first two being designated low, and the second two high, concentrations. The results show that the high concentrations very materially reduced bud-drop, produced smaller and firmer flowers, a smaller volume of, and less succulent and mechanically stronger roots, and a reduction in both linear growth and green weight of the tops. In chemical composition all parts of the high concentration plants were relatively high in carbohydrates and ash, low in water content and the simpler organic compounds containing nitrogen. A larger proportion of the more complex forms of organic nitrogen, usually associated with storage, and a relatively low reducase activity were also found. It is concluded that the high concentrations limited bud-drop by affecting the environment and responses of the plant in a more or less definite sequence. In seasons of greater sunlight, however, lower concentrations would be desirable and experiments are at present being made to determine means of altering nutrient concentrations under glasshouse conditions.

[2] The second paper describes a study of the anatomical changes accompanying the formation of an abscission layer in sweet pea buds which was made in an attempt to find a control for bud-drop. The opinion is expressed that bud-drop may be a result of desiccation and degeneration of the flower parts, which in turn may be caused by an upset in carbohydrate-nitrogen balance during periods of cloudy weather.

815. HANSON, A. J., AND WEBSTER, R. L. 635.656 : 632.78

The pea moth *Laspeyresia nigricana* Steph.

Bull. Wash. St. agric. Exp. Sta., 327, 1936, pp. 22, bibl. in text.

The insect, its distribution and the nature of the injury it causes are described. All species of *Pisum*, *Vicia* and *Lathyrus*, including peas, vetches and sweet peas may be attacked, and the larvae have also been observed in lupins and Scotch broom. Preliminary spraying experiments show little promise for the use of insecticides. Tests with parasites are still in the experimental stage. The only control measures suggested are, therefore, limited to the following:—For dried peas, rotating crops so as to plant peas as far away as possible from the preceding year's crop; for pod peas, removing the old vines as soon as the last picking has been made and feeding them to stock or burning them; and for canning peas, segregation into areas where vetches and seed or dried peas are not grown, since canning peas are harvested before the pest completes its life-cycle and hence do not provide a source of reinfection. Recommendations made elsewhere include the use of early-maturing varieties and deep ploughing in the autumn.

816. POST, K. 635.936.832

Some effects of temperature and light upon the flower bud formation and leaf character of stocks (*Matthiola incana*).

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 649-52, bibl. 2.

The experiments were made on stocks of the non-branching, lilac, lavender variety in a greenhouse during the winter. Plants grown at temperatures continuously above 60°F. produced no flower buds. When day temperatures were kept above 60° and night temperatures below 60° they also failed to flower, but when night temperatures were kept above 60° and day temperatures were reduced below 60° flowers were produced. Similarly plants grown continuously at temperatures below 60° flowered. Leaf characters were also altered by each set of temperature conditions and are described. The production of entire leaves was accompanied by flower bud formation. A 14-day treatment at 50° to 60° was sufficient for some plants to form buds, and 21 days at low temperatures was sufficient for all the plants to form buds, if they were started after 28 January, or at the time had attained the proper size for bud formation. After a low temperature period of 21 or more days, however, an increase in temperature hastened flowering.

817. HANSING, E. D., AND OTHERS. 635.937.15

Hardiness tests of some perennial sedums.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 686-9, bibl. 1.

Tests were made in Minnesota to determine the relative hardiness of 16 different species of *Sedum*, using artificially controlled low temperatures. Records were taken of leaf and stem

killing as well as of root killing, since these parts are able to propagate the species. It was found that there was a very wide range in the ability of the species to harden, and this capacity was found to be fairly closely related to the regions to which the plants were native. Species native to northern parts of Europe, Asia and the U.S. proved hardy and were hardened to resist $-8^{\circ}\text{C}.$, whereas types native to Mexico and the Mediterranean basin showed degrees of killing at $-4^{\circ}\text{C}.$

818. WHITE, H. L.

635.936.69 : 632.48

On *Verticillium* wilt of the perpetual-flowering carnation.

J. Pomol., 1936, **14** : 216-26, bibl. 4.

Experiments at Cheshunt have shown *Verticillium cinerescens* to be the most important of the diseases which cause "stem rot" in the perpetually flowering carnation, various species of *Fusarium* causing different and not such important symptoms. It is shown that the *Verticillium* disease is conveyed from crop to crop in the cuttings. Using the varieties Topsy and Spectrum and different strains of *Verticillium* a differential susceptibility of varieties towards different strains of the disease was shown to exist. Attempts to infect tomato, chrysanthemum and aster with the disease failed. The control methods considered most likely to be successful are:—steam sterilization of soil and alternation of crop. To prevent reinfection is more difficult. It is suggested that care should be taken to avoid contamination of fresh ground by the introduction of contaminated soil, tools or water, and that cuttings from infected beds should not be used.

819. SPEYER, E. R.

632.73 : 635.936.69

1. "Thrips" injurious to the carnation plant.

2. Experiments in the control of *Thrips tabaci*.

Annu. Rep. Res. Sta. Cheshunt for 1935, 1936, **21** : 63-8, bibl. 1, and 68-70.

Part 1 describes a study of the life-cycle of *Thrips tabaci* Lind. on glasshouse carnations, which it injures by producing fleck markings on the flowers. Part 2 is devoted to dusting and spraying trials. Pyrethrum dust alone and in a mixture of 1 to 9 with flowers of sulphur was applied at intervals of 3, 7 and 14 days from 10 days before any of the blooms opened onwards. When the petals began to open, however, they were found to be already severely marked by thrips, and, since the dusts also rendered the foliage unsightly and the one containing sulphur caused severe injury to the blooms during sunny periods, the treatment was abandoned. Sprinkling grade 16 naphthalene over the plants after all blooms showing thrips markings had been removed appeared to have some effect in preventing adults visiting new flowers, but it is doubtful if the method would be of practical value commercially. Naphthalene fumigation performed twice at a rate of 2 lb. per 3,000 cubic feet against red spider mite was followed also by a cessation of thrips attack. It is pointed out, however, that the fumigation was done late in the season, and hence caused no apparent foliage injury, and that it is unlikely to have destroyed all the thrips pupae in the soil.

820. READ, W. H.

632.452 : 635.937.34

Rose rust.

Annu. Rep. Res. Sta. Cheshunt for 1935, 1936, **21** : 76-8.

Further attempts to obtain a reliable spray treatment for infections of *Phragmidium* are reported, but have so far proved unsuccessful. Copper oxychloride, which has been found to give the best control of rose mildew, *Sphaerotheca pannosa*, has proved ineffective in controlling rust.

821. SPEYER, E. R.

632.73 : 635.937.34

Rose thrips (*Thrips fuscipennis*, Hal.).

Annu. Rep. Res. Sta. Cheshunt for 1935, 1936, **21** : 70-2.

Dusting with pyrethrum alone and with flowers of sulphur has been found to have no appreciable effect upon the thrips, and in addition the sulphur mixture caused severe foliage injury. In

poison-baits containing 1% sodium fluoride, applied to flowers containing the insect, brown sugar proved better than white as an attractant, and treacle was unattractive. Further investigations are needed, however, since no bait treatment has yet proved entirely effective, and sodium fluoride when applied as a spray in dilutions as low as 0.3% caused definite foliage scorching.

822. OYLER, E., AND BEWLEY, W. F.

635.939.124 : 632.411

A disease of cultivated heaths.

Annu. Rep. Res. Sta. Cheshunt for 1935, 1936, 21 : 50-6.

A wilt disease of heaths, *Erica hyemalis*, *E. nivalis* and *E. Willmoreana*, caused by *Phytophthora Cinnamomi* Rands, has been investigated, and inoculation experiments and studies of conditions governing spore production and liberation and of sources of infection are described. The disease usually appears 6-8 weeks after standing the plants outside in the open or in pits. In control experiments it has been found that cultures of the fungus are readily destroyed by Cheshunt compound, copper sulphate, mercuric chloride and sodium chlorate. Copper sulphate at the rate of 1 oz. dissolved in 8 gallons water is recommended as a disinfectant because of its low cost and safety. 1 gallon of this solution should be applied per square yard of the "standing-out" ground. Water tanks were found to be a source of infection and may be sterilized with formaldehyde after being cleared of debris and scrubbed. Some form of covering for the tanks is essential to prevent infected roots with the surrounding peat compost from being thrown into them. Since the fungus also attacks beech seedlings, peat from the neighbourhood of beech trees should be rejected. Pots, boxes, etc., which have been used previously for the cultivation of heaths or of *Antirrhinum*, *Calceolaria* and *Schizanthus*, which are also host plants, should be sterilized by heat or formaldehyde. Finally all roots and balls of compost from diseased or rejected plants should be burnt or sterilized by heat before storing.

CITRUS AND SUB-TROPICALS.*

823. TANAKA, T.

634.3

Studies in the origin of *Citrus* flora of various localities [Japanese, English summary].

Commun. hort. Inst. Taihoku Imp. Univ., **45**, 1935, reprinted from *Proc. Jap. Ass. Adv. Sci.*, 1935, vol. **10**, No. 2, pp. 570-6, bibl. 9.

The examination of local citrus floras show that each flora is composed of certain primary elements representing systematic groups of the genera and secondary varieties derived from them. 15 primary species are named. The reason why *C. Aurantium* has produced no new types in Europe or *C. grandis* in South China, whereas in Japan hybrid varieties from these species are numerous, is that in the two former localities the species stands alone without access to other conjugally compatible species, while in Japan and India this is not so.

824. TANAKA, T.

634.3

On the origin and the future of Japanese *Citrus* flora. [Japanese, English summary.]

Commun. hort. Inst. Taihoku Imp. Univ., **51**, 1936, reprinted from *Studia citrol.*, 1936, **7** : 155-75, bibl. 4.

The earliest known indigenous citrus of Japan as far as is shown by early literature is the variety now known as *Citrus tachibana* Tanaka. The earliest imported variety (69 B.C.) is *Citrus Aurantium* (sour orange). The variety *C. benikoji* Hort., a large-sized orange, was first noted in A.D. 797. It has now passed out of cultivation in Japan but is still grown in parts of China and Korea. *C. junos* Sieb. and *Poncirus trifoliata* Raf. also appeared about this time, both from Korea. *C. kinokuni* Hort. first attracted written notice in the tenth century and *C. leiocarpa*

* See also 921.

Hort., a chance seedling (from *C. kinokuni*) was given the same Japanese name "Koji" and finally usurped and still retains it. *Citrus medica* L. (citron), *C. nobilis* Lour. (mandarin), *Citrus grandis* Osbeck (shaddock) first appeared in the tenth century and *Fortunella japonica* Swingle (kumquat) and *C. erythrosa* Hort. about the fifteenth century. Between A.D. 1550 and 1700 there was a noticeable increase in varieties of *C. junos*, sour orange, citron, and shaddock. The only foreign species introduced in this period was *C. tangerina* Hort. (tangerine). From A.D. 1700 to 1900 imported species were *C. sinensis* Osbeck (sweet orange), *Fortunella margarita* Swingle (oval kumquat), *F. Hindsii* Swingle (Hongkong kumquat), and *C. Limonia* Osbeck (lemon), but *C. yatsushiro* Hort. appeared as a chance seedling as did too the now important *C. unshiu* (Satsuma orange). Old varieties such as *C. kinokuni* and *C. leiocarpa* began to produce a remarkable number of varieties at this time while the increase of hybrids containing *C. Aurantium* or *C. grandis* blood was notable. Since 1900, varieties of the sweet and loose skinned oranges are increasing steadily but the only importation of note is *C. paradisi* Macf. (grapefruit). It is pointed out that this great increase in variety would never have occurred if the horticulturist had not intervened, and it is essential that his work of selection and hybridization should continue, particularly with the loose skinned orange of which a collection of every type is much needed.

825. TANAKA, Y., AND YAMASHITA, T. 634.31
Investigations on the character of Satsuma orange varieties. [Japanese, English summary.]
Commun. hort. Inst. Taihoku Imp. Univ., 55, 1936, reprinted from *Studia citrol.*, 1936, 17 : 2 : 190-207.

The season of greatest palatability of the various strains of Satsuma orange was determined for Formosa and lies between 22 August and 1 October. Maximum palatability is assumed to be the period when the sugar : acid ratio reaches 10 and the total acid decreases to 0.5% or the specific gravity goes down to 0.9. Some varieties of the Wase strain on these standards kept their palatability for only 19 days, whereas other varieties of Wase were at their best for 58 days. Compared with the Satsuma growing districts of Japan both blossoming and fruiting are 45 days earlier in Formosa. The Formosan Satsuma is larger, less shapely and of poorer colour than the Japanese, while its taste is insipid and the juice often dries up within the fruit very rapidly.

826. ZARETSKY, A. J. 634.324-2.111
Kumquats and their hybrids. [Russian, English summary.]
Soviet Subtropics, No. 7 of 1936 (23), pp. 42-50, bibl. 13.

Results are described which have been obtained in the crossing of *Fortunella* spp. with *Poncirus trifoliata* (trifoliate orange) and others with the object of increasing the frost resistance of citrus fruits in S. Russia.

827. CLARK, H. D. 634.3-1.542.3
Citrus tree form and production.
Calif. Citrogr., 1936, 21 : 290, 294-6.

The citrus tree framework should consist of 3 to 5 main limbs properly separated for balance and growing space to support the fruiting branches. In the haste for early production this principle has been largely lost sight of. The author attributes biennial bearing and the decreasing quality and quantity of fruit in the older groves, which no changing of soil or fertilizer practice has overcome, to this early neglect. At 10 feet high the separation between the frame branches should be not less than 6 feet across the centre and 5 feet elsewhere. To reconstruct a tree of the heavy timber type such as so many have become, the centre pole with its umbrella top which shades the interior of the tree must be entirely removed, a process which may take two or three years. The inside or fruiting branches should not be removed from the frame branches since all that these require to bring them into bearing is the admission of light and air, which

the removal of the centre pole will ensure. Trimming or thinning the top of the centre pole is useless. It is true that it results in new interior growth but this is again shaded out within two years. The severe cutting back of outer frame limbs is deprecated. The subsequent close growth tends to close rather than open the top, but dense walls and old side branches may be removed with advantage. It is wasting money to remove interior dead wood from dense trees since such trees have no interior fruit to be injured. The work of attempting to change the form of a tree should not be undertaken without careful preliminary analysis of the structure. The objects to be attained are maximum sunlight or fruiting area, minimum number of frame limbs to obtain balance and openness, uprightness and strength of frame limbs to support the maximum number of fruiting branches and crop, a size and form of tree which will provide easy access for all cultural operations. Only an open centre tree can provide these features and open centre does not mean that the inner sides of the frame branches should be bare of laterals. On the contrary they should be as well furnished and productive as the outer sides.

828. GUSEVA, E.

634.322

Crown development of mandarin trees. [Russian, English summary.]

Soviet Subtropics, No. 8 of 1936 (24), pp. 23-7.

A study was made of the crown development of mandarin trees from 1-25 years old. Data were obtained on the total number of branches, the length of seasonal shoot growth, number of leaves, distribution of fruit and percentage of fruit buds on the shoots at different stages. The branches fell into 8 categories. It was found that first grade fruits occur on the twigs developing from the secondary growth on the outer part of the crown. Twigs on old wood inside the crown bear poor grade fruit. New growth within the crown does not fruit. First year fruiting shoots give a higher percentage of fruit buds than second year growth. Thinning was found to increase quality and yield.

829. WRIGHT, N.

634.3 : 581.145.2

Additional notes on the seedlessness of citrus fruits.

Trop. Agriculture, Trin., 1936, 13 : 283-4, bibl. 6.

In this paper is summarized further information which has been received since, and partly as a result of, the publication of the author's paper on the seedlessness of citrus fruits, with particular reference to Marsh grapefruit. [*Ibidem*, 13 : 118-22, *H.A.*, 6 : 2 : 363.] Two Satsuma varieties growing in Florida orchards were for all practical purposes seedless though locality appeared to exercise some slight influence, possibly through opportunities for cross-fertilization, since self-pollination in this variety is structurally impossible. The degree of female sterility is high. Acid limes had a few seeds, except the Tahiti which is practically seedless. Lemons showed wider fluctuations but in neither case could exterior causes for these variations be found. Referring to miscellaneous crosses the recent work of Toxopeus is quoted* in which it is shown that *C. aurantifolia* and *C. medica* var. *Limon* L.† as pollen parents produce less seed than other varieties on the same mother plant.

830. BIALOGLOWSKI, J.

634.334-1.535

Effect of humidity on transpiration of rooted lemon cuttings under controlled conditions.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 166-9, bibl. 4.

Under conditions of an artificially controlled environment, the loss of water from rooted lemon cuttings was not directly related to the saturation vapour pressure deficit. At 30°C. the rate of transpiration is a function of humidity in the range of 95 to 60% humidity. A very marked retardation takes place below 60%. At 25 and 20°C. the effect of external factors is most

* *Züchter*, 1936, 8 : 1-10, *H.A.*, 1936, 6 : 1 : 135.

† *C. Limonia* Osbeck.

accentuated, resulting in a straight line relationship between transpiration and humidity. [From author's summary.]

831. TOXOPEUS, H. J. 634.31-1.541.11

Stock-scion incompatibility in citrus and its cause.

J. Pomol., 1936, 14 : 360-4, bibl. 2.

Sweet orange (*C. sinensis*) scions have proved incompatible with rootstocks of many other citrus species and hybrids in Java. On sour orange (*C. Aurantium*) stocks, in particular, the buds united and grew normally for 2-3 months, but thereafter showed various symptoms of decline, and usually died within 8-12 months. In double-working experiments with sweet and sour oranges and with the Japanese citron, which is compatible with both the other species, it was found that, unlike comparable cases of pears on quinces, the use of a compatible intermediate neither prevented nor delayed decline. It was further discovered from combining the three species in all possible positions that failure occurred only when the scion was sweet orange and the stock or intermediate sour orange. The insertion of both sweet orange and Japanese citron buds into sour orange stocks resulted in death of the plants. The inarching of sweet oranges with both sour orange and Japanese citron stocks resulted in failure of the sour oranges only. These results indicate that the sour orange stock does not injure the sweet orange scion, but suggest that the scion produces some substance toxic to the stock.

832. HODGSON, R. W., AND OTHERS. 634.337-1.541.11

Rootstocks for the Bearss lime in California—a progress report.

Calif. Citrogr., 1936, 21 : 280.

The Bearss Seedless lime (the Persian or Tahiti type of *Citrus aurantifolia*) is the lime most extensively planted in California. Rootstock trials with this as a scion variety have been in progress for 8 years at the University of California, Los Angeles. As the result of the trials the different rootstocks are ranked for size of cross section 8 inches above bud union, volume of top and yield in descending order as follows:—grapefruit, rough lemon, sweet orange, sour orange, trifoliate orange. The dwarfing effect of trifoliate is very pronounced and probably indicates incompatibility. Sour orange also gives a degree of dwarfing. In all cases the scion overgrows the stock at the bud union most markedly in trifoliate and to a lesser extent in sour, grapefruit, sweet and rough lemon in descending order. Stock influence on fruit characters is not apparent from a superficial study, except that the fruit on trifoliate is smaller. Bearss lime of the same age on its own roots from cuttings ranks in size above sour orange and may prove as satisfactory as trees on any of the rootstocks tried.

833. RYNDIN, N. A. 634.334

A new solution of the lemon problem. [Russian, English summary.]

Soviet Subtropics, No. 11 of 1936 (27), pp. 56-9.

Lemon trees in S. Russia suffer severely from occasional heavy frosts when many trees are lost. It is suggested that the lemon should be budded into the crown of the mandarin, *Citrus nobilis* var. *unshiu* (Satsuma), which is the most frost-resistant variety, so that the lemon and mandarin co-exist on one stock. Should the lemon suffer frost injury the mandarin will still survive, its crop will still be marketable and in the meantime it can be partially rebudded to lemon.

834. HALMA, F. F. 634.334-1.541.11

An unusual citrus rootstock.

J. Hered., 1936, 27 : 205.

In a lemon orchard growing on lemon rootstocks, identified from sprouts as of the Lisbon or Villafranca type, one rootstock produced sprouts of an unusual type. Three trees of this type, raised from cuttings, have borne very long fruits with a distinct neck, which up to the present have been entirely seedless. A resemblance to a Mediterranean lemon variety has been noted, but whether it has arisen from a forgotten importation or is a mutation is not clear.

835. HAAS, A. R. C. 634.3 : 581.145.1

Chemical composition in flowers of citrus varieties.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 61-6.

Experiments were made to determine the chemical composition of citrus flowers [lemons, oranges and a grapefruit.—ED.] and to note possible varietal differences. The data suggest that when citrus trees bloom excessively, but lose many of their flowers, there is a considerable loss of inorganic and organic constituents, unless their re-transport takes place. The materials lost in this way would otherwise be utilized in vegetative growth and in the development of the fruits actually set. The vigour or thrift of the tree is correspondingly reduced, with the result that a lowered resistance is presented to environmental and other factors. The relation of flowering to the economy, nutrition, and health in citrus deserves further study. [Author's summary.]

836. CAMERON, S. H., AND OTHERS. 634.3 : 581.145.1

Seasonal changes in the nitrogen content of citrus fruits.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 87-9, bibl. 5.

Determinations of the nitrogen content of fruits of Eureka lemon, Washington Navel orange, Valencia orange and Marsh grapefruit were made at fortnightly intervals at Riverside, California, and also in the case of the two oranges, at Los Angeles. Total nitrogen, estimated by the Kjeldahl-Gunning method, increased at an approximately constant rate throughout the period of development. The dry weight of the fruit at first increased relatively more rapidly than the nitrogen and later rather more slowly, so that the percentage of nitrogen on a dry weight basis at first declined steadily and later rose. In the case of Valencia orange and grapefruit the results indicate that nitrogen will continue to increase so long as the fruit remains hanging on the tree, until it contains from 20 to 25% more nitrogen than fruit picked when horticulturally mature. Whether this additional withdrawal of nitrogen from the tree affects subsequent crop production is uncertain, but in view of the possibility that the common practice of leaving horticulturally mature Valencia oranges on the tree until required may accentuate a biennial bearing tendency, the question of nitrogen withdrawal requires consideration.

837. HALMA, F. F. 634.3-1.436

Effect of soil temperature on growth of citrus.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 67-9, bibl. 1.

Rooted cuttings of Eureka lemon, Marsh grapefruit and Valencia orange were grown without protection for nearly one year, during the winter and spring of which three ranges of soil temperature, 16° to 27°C., 12° to 22°C. and 3° to 20°C., were maintained. The lemon made greatest total growth at the highest temperature range and the grapefruit and orange at the intermediate temperature range, but these were exceeded by the minimum growth made by the lemon at the lowest temperature range. Grapefruit made little and orange practically no growth at the lowest temperature range, and it is concluded that they both show a smaller degree of adaptability to soil temperature than does lemon.

838. HARVEY, E. M., AND RYGG, G. L. 634.323 : 581.145.2

Field and storage studies on changes in the composition of the rind of the Marsh grapefruit in California.

J. agric. Res., 1936, 52 : 747-87, bibl. 24.

The results of two series of studies are presented in this paper. I. *Normal seasonal changes of grapefruit rind in the field*.—Analyses indicated that, although the rind of fruits from three districts in California did not show identical seasonal changes in composition, the following were the general trends :—Increases occurred in water and soluble solids, while the flavedo-albedo (yellow to white rind) ratio, total sugar and invert sugar increased and then tended to decrease.

Naringin, hydrolyzable polysaccharides, and hydrogen-ion concentration tended to decrease throughout the season, the last named, however, only very slightly. The invert-sugar graphs ran parallel to the mean air-temperature graphs, while the graphs for reducing sugar were somewhat the inverse of the mean air-temperature graphs. Comparisons of the stem- and blossom-end rinds and of flavedo and albedo indicated that, while the fruit from one locality might show greater differences than the fruit from other localities, the differences were in no case as great as those found in oranges (see abstract 839). II. *Storage studies* :—Fruits from the same three districts were stored at 32°, 42° and 52°F. with these objects :—(1) to determine some of the general chemical changes occurring in the rind during storage, (2) to note the relation of such changes to the previously determined condition of the rinds at the time of picking, (3) to correlate the findings with the susceptibility of the rinds to pitting and spotting, and (4) to study the effects of various treatments on pitting and spotting. Fruit from the different localities, in addition to differences in pre-storage composition, showed somewhat different chemical responses to storage conditions. In particular, it is noted that naringin in the rinds was hydrolyzed in the fruit from two localities and synthesized in the fruit from the third locality. The most severe pitting and spotting occurred at 42°F. in all cases, and the least at 52°, with 32° intermediate. The picking season had a distinct influence : of the fruit stored at 42° that picked early in the season was the most severely affected, but of the fruit stored at 32° the early picked fruit was less affected than the late. Fruit held for a period at 52° and then transferred to lower temperatures spotted only slightly, but fruit held at 42° or 32° continued to spot when transferred to 52°. Pitting and spotting was accelerated and enhanced in weakly acidified atmospheres, whereas it was apparently retarded by weak alcohol and ammonia. Alcohol also retarded the development of yellow colour in the stored fruit. The permeability of the rinds to their own soluble substances increased as the storage temperature was lowered, which may have a bearing on the breaking down of fruit tissues in cold storage. No correlation was found between pectin content of the rind and temperature, on the one hand, and spotting of the fruit on the other. Storage temperatures also produced no significant alteration of the buffer system. Experiments in which naringin and its phenolic derivative, naringenin, were injected into the albedo of grapefruit rinds revealed that naringenin was approximately 1,000 times more toxic to rind tissue than naringin. When rinds were injected with dilute naringenin solutions the most severe injury occurred when the fruit was kept at 42°F., and after about 5 days spots similar to those commonly observed in storage often developed. Different degrees of susceptibility to naringenin injury were exhibited by individual fruits and also by the fruit of individual trees considered collectively. In general uninjected fruits from very susceptible or resistant trees, when stored for some weeks at 42°F., developed degrees of spotting in rather interesting agreement with the susceptibility or immunity to naringenin injury previously noted for them.

839. HARVEY, E. M., AND RYGG, G. L. 634.31 : 581.145.2
Physiological changes in the rind of California oranges during growth and storage.
J. agric. Res., 1936, 52 : 723-46, bibl. 9.

The comprehensive investigation described in this paper formed part of a general physiological study of the rind of citrus fruits with particular reference to the causes of certain rind pitting and spotting diseases that occur during transportation and storage. The material consisted of Valencia and Washington Navel oranges from the districts of Pomona and Corona in California, and the analyses were made during the 1932-33 season. In the rind as a whole the following seasonal changes in composition were found :—*Valencia* :—a slight upward trend in water content ; practically no change in total sugar, invert sugar increasing as reducing sugar decreased ; only slight changes in nitrogen content, although the proportion of soluble and insoluble fractions fluctuated to some extent ; while hydrolyzable polysaccharides varied with the mean temperature and soluble solids varied inversely with the mean temperature. *Washington Navel* :—a slight seasonal downward trend in water content ; an increase in total sugar due principally to a steady increase in reducing sugar ; a general relative increase in soluble solids ; and decreases

in hydrolyzable polysaccharides, hesperidin and hydrogen-ion concentration. A comparison of the stem and blossom ends showed a definite difference in composition during the season. In both varieties the stem end was higher in water, reducing sugar and soluble solids. In Valencias the stem end was higher in soluble nitrogen, and the blossom end in total sugar. In Washington Navel the stem end was higher in total sugar, and the blossom end in invert sugar, hydrolyzable polysaccharides, insoluble solids, hesperidin and hydrogen-ion concentration. A comparison of the flavedo and albedo, the yellow and white parts of the rind respectively, showed that in Valencias the flavedo-albedo ratio was always greater than unity, being highest during the hottest weather, but that in Washington Navel it varied on either side of unity, though averaging more than unity, particularly at the blossom end. In both varieties the flavedo contained a higher percentage of invert sugar and soluble solids, and the albedo a higher percentage of water, insoluble solids and hydrolyzable polysaccharides. In Valencias the flavedo was higher in total sugar and nitrogen, and in Washington Navel the flavedo was higher in reducing sugar and the albedo in hesperidin and hydrogen-ion concentration. Several differences were found between the rinds of oranges from the Corona and Pomona districts. The following results were obtained from storage experiments with Valencias kept at 33° and 53°F. for 7 weeks: (1) The stem-end rind lost water more rapidly than the blossom-end rind; (2) soluble solids always decreased more rapidly at 53° than at 33°; (3) the stem-end rind lost soluble solids twice as rapidly as did the blossom-end rind; (4) reducing sugar changed very little, but invert sugar almost disappeared at 53°; (5) rind from fruit stored at 33° had a higher hydrogen-ion concentration than that stored at 53°, and the stem-end rind than the blossom-end rind. With Washington Navel oranges stored at 52°, 42° and 32°F. the following responses were obtained:— (1) The stem-end rind always showed greater responses to storage conditions than the blossom-end rind except in acidity; (2) at all temperatures and in all parts of the rind acidity increased, the increase being greatest at 52° and least at 32°; (3) invert sugar decreased slightly at 32° and greatly at 42° and 52°; (4) reducing sugar changed much less than invert sugar, but in the same direction; (5) hesperidin showed marked increases, the increase being relatively greatest at 52°; (6) soluble solids decreased most at 52°; (7) hydrolyzable polysaccharides changed very slightly at any temperature; (8) the flavedo-albedo ratio increased slightly in the stem end, but decreased to exactly the same extent in the blossom end. It is pointed out that in California Washington Navel oranges are harvested in winter, and Valencias in summer, which makes it difficult to distinguish between differences which are varietal and those which are caused by environment. The storage experiments with Washington Navel oranges indicate that late-picked fruit is more susceptible than early to brown stain, and that susceptibility is increased by storage at 32° as compared with 42° and 52°F. There is also some evidence that susceptibility to pitting and spotting varies with the environmental factors of the last few days preceding the picking of the fruit.

840. MULLER, H. R. A.

634.3 : 581.144.2

Mycorrhiza van Citrus. (*Citrus mycorrhiza*.) [Dutch, English summary.]*Landbouww.*, 1936, 12 : 1-10, bibl. 7.

This paper is a detailed review of Reed and Frémont's publication on mycorrhiza in *Citrus* roots (*Revue de Cytologie et Cytophysiologie végétales*, 1935, 1 : 327-48). The author disagrees with Reed and Frémont regarding intercellular digestion of fungus hyphae by the host. He regards only as true digestion intracellular digestion by the direct action of the host cytoplasm, and the disappearance of the intercellular mycelium in the aging tissues of the cortex as a phenomenon of autolysis of the hyphae following their death caused by the disintegration of the feeding haustoria within the plant cells. Again Reed and Frémont regard mycorrhizae in *Citrus* as bearing a beneficial relation to the plant. The author on the other hand considers them to be exclusively endotrophic mycorrhizae and to be parasitic associations of fungi in the roots. The third point of disagreement is with Reed and Frémont's statement that in *Citrus* mycorrhizae are very inconstant associations largely depending on a number of external and internal factors. The author says, on the contrary, that the mycorrhizae in *Citrus* are dependent entirely on the

conditions influencing the development of the root, they are entirely endotrophic and not ecto-endotrophic as in *Pinus*. The fact that healthy citrus trees in well manured soils show regularly developed intracellular mycorrhizae whereas the poorly growing trees show a more parasitic, mainly intercellular and persistent development of the endophyte is, the author considers, a consequence and not the cause of the differences in the vigour of the tree. He explains at some length why this is so.

841. NADEL, M. 581.12

Influence of fixatives on stomatal behaviour.

OPPENHEIMER, H. R.

Critical remarks on the value of Lloyd's alcohol fixation method for measuring stomatal aperture.

Bull. Rehovoth agric. Exp. Sta., **16**, 1935, pp. 3-23, bibl. 28, and pp. 25-9, bibl. 7, reprinted from *Palestine J. Bot. hort. Sci.*, 1935, vol. **1**, No. 1.

Since Lloyd's alcohol fixation method for measuring stomatal apertures has been found unsuitable for use with citrus species, an attempt was made to determine if other materials might prove satisfactory for the purpose. In the first of these papers tests with Carnoy's mixtures, Pfeiffer's mixture, acetone, iodine, glacial acetic acid, formalin, liquid paraffin, ether, petroleum, xylol and benzol on leaves of *Citrus sinensis* are described. None was found to preserve the actual state of aperture of the stomata existing at the time of fixation. Xylol and benzol caused the stomata to open, whereas all the other reagents caused them to close. On the other hand, in similar tests with potato leaves, xylol caused the stomata to close, whereas placed in Carnoy's solution they opened. These specific differences in the reaction of the two species to the same reagent are thought to be explained by differences in the structure of the membrane of the stomata, and particularly in the arrangement and relative quantity of the layers composed of cutin and cellulose. In the second paper Oppenheimer concludes his remarks on Lloyd's method by expressing agreement with Renner's opinion that the method is distinctly dangerous and requires a searching critical examination, but he does not agree with Renner in calling it very serviceable. The literature on the subject of the fixation of stomata is reviewed in some detail in both papers.

842. MCGEORGE, W. T. 634.3-1.415.3-1.8

Acidulated fertilizers for alkaline soils.

Calif. Citrogr., 1936, **21** : 368, 384.

It is suggested that fertilizers fortified with residually acid materials could be used to great advantage on alkaline or calcareous soils particularly in the case of permanent orchard crops where, for example, chlorosis is prevalent. Small amounts of zinc or iron salts, which are often deficient in such soils, could be added. The most suitable acid fillers for such acidified fertilizers would be acidulated tankage or other acidulated organic material and sulphur.

843. KINNISON, A. F., AND ALBERT, D. W. 634.323-1.8

A progress report on fertilizer studies with grapefruit in the Salt River Valley, Arizona.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, **33** : 90-1, bibl. 1.

Results from four years of fertilizer plot studies with Marsh grapefruit trees, which were 18 years old when the trials started, are reported. All plots, including checks, received an initial uniform application of farmyard manure. Of the fertilizer treatments superimposed upon this only an application of 10 lb. treble-superphosphate per tree has shown an economic increase in yield and improvement in grade of fruit. Supplementary applications of nitrogen and extra farmyard manure have tended to lower the grade of fruit and reduce rather than increase yield. Potash,

though known to occur in adequate quantities in local soils, has maintained previous production performance, and has produced a better grade of fruit than the check plots.

844. TAYLOR, C. A., AND FURR, J. R. 634.334-1.432

The effect of decreasing soil moisture supply on size of lemon fruits.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33: 71-81, bibl. 6.

The volume of lemon fruits is shown to fluctuate in response to changes in moisture supply to the tree and in accordance with transpiration opportunity. In this paper problems associated with the taking of soil moisture samples and root distribution are discussed in some detail. Objection is raised to the use of single-valued averages of specific soil moisture determinations for the type of correlation required, and instead ranges in soil moisture are advanced as more descriptive of the true state of affairs. Thus for example a wilting range is established between a first wilting line, as representing the soil moisture content at which the lower leaves of sunflowers first wilted, and an ultimate wilting point at which the plants were completely wilted. Ranges were determined for the first and second 6 inches of soil and for the second and third feet. Root concentrations of lemon trees were estimated for the first, second and third feet. Fruit volumes were measured daily throughout September, October and November and were found to increase steadily until 30 September, when a reduced rate of increase first indicated a moisture deficit. An estimation of soil moisture made on this date revealed that the major part of the root system was in soil which was below the half-point on the scale of available moisture, but was still above the first wilting line as indicated by sunflowers. By 14 October the moisture deficit in the fruit had increased to a point at which large fruits made no further increase in size, and on this date nearly all of the top 2 feet of soil, in which 78% of the root concentration in the top 3 feet of soil was to be found, was below the moisture content corresponding to the first wilting line. The relationships established here have been used as a basis for further experiments, the results of which are abstracted in the same volume of *Proc. Amer. Soc. hort. Sci.*, page 70, but are to be published in full elsewhere.

845. SOFOTEROV, N. K., AND NADARAYA, G. B. 634.334-2.111

The covering of lemon trees in winter. [Russian, English summary.]

Soviet Subtropics, No. 9 of 1936 (25), pp. 8-23.

Eight-year-old lemon trees were successfully protected from frosts of short duration by envelopment with canvas-covered cone-shaped frames. Similar frames covered with straw and lined with mulched paper and open on one side also gave good protection. The following covers were less successful—bamboo mats, three-ply muslin, acetyl celluloid film in one and two ply. It is stated that the use of the successful covers modifies the physiological processes in the plant and increases its powers of frost resistance*.

846. SHEPHERD, J. D., AND OTHERS. 634.3-1.67

Report on duty of water investigations on citrus cultivation at Gan Moshe, near Rishon le Tsiyon during the years 1931-32-33.

Rep. Dep. Development, Palestine, 1936, pp. 28.

The objects of the investigation are to ascertain the optimum duty of water in a certain grove, the most desirable method of irrigation culturally and economically, and to provide data which are capable of being applied by growers to varying soil conditions and plantation layouts. The investigations are reported in detail. General conclusions reached are that an unnecessarily and even injuriously high quantity of water is used in irrigation in Palestine, but that reduction in a grove accustomed to water in large quantities must be done by degrees. The advantages of furrow over basin irrigation are emphasized. The former uses less water and the costs are very

* Selianinov, G. T. *Ibidem*, 1936, 10 (26) on p. 17 (not abstracted) says that covers lower frost resistance and are generally colder inside than out.

much less, the soil is more simply and economically tilled, while the root system spreads over the whole grove at an early date. If carried out properly scouring is reduced and it can be employed on steeper slopes than is possible under basin irrigation. The investigations are continuing.

847. LOMBARD, T. A.

634.334-1.67

Irrigation of lemons for optimum vigor without reduced production.

Calif. Citrogr., 1936, 21 : 366, 406-7.

The difficulties of controlling irrigation so that the individual tree gets neither more nor less than the amount of water required are discussed. For instance young trees require more water than older trees, also in many soils where long irrigation furrows are used the top end of the field, where the water enters, may be over irrigated while the trees at the far end may not receive enough. In both cases the trees and the yield suffer and a great deal of water is wasted. There is, too, the loss from erosion which may amount to 30 cubic yards of the best soil per acre per annum. Devices used on the Sespe ranch, California, to cope with these evils are described. 500 gallon tank waggons are used for giving additional water to young trees standing among maturer trees or to irrigate gravelly spots in the orchards or any parts which dry out more quickly than the rest. A single furrow at the upper end may be made to branch into several at the lower end. Where there are several pipe lines in an orchard, the run-off water from one section is concentrated into one of the centre furrows of the section below it, thus enabling that furrow to be missed when the lower line is irrigated. By the use of a small steel penetration rod it has often been found that after a few hours the water in the furrows adjacent to the trees can be shut off while the centre furrows require longer hours. Great numbers of small drains, constructed of 24" x 8" galvanized sheets folded to form a V, are placed in the bottom of furrows at the lower end of runs and serve to hold back both water and silt. Where such dams have been placed, the penetration in a given time has more than doubled. A progress report of some experimental irrigation plots is given. These show an increased production of yield up to 25" of water annually, with a sharp drop at 29" and a yellowing of leaves. Since trees in this area can only use 18" of water and the difference in production between those receiving 18" and 25" is 35 lb. per tree, it is considered that the wetter rows had the salt leached out more readily by the winter rains and so maintained better growth conditions. The 29" of water excluded air from the soil for too long and caused root decay.

848. PARKER, E. R.

634.3-2.19

Experiments on the treatment of mottle-leaf of citrus trees. II.*

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 82-6, bibl. 6.

Citrus trees affected with true mottle-leaf have shown marked responses to zinc sulphate and zinc sulphate-lime sprays, regardless of the type of soil in which they were growing. Trees affected with a mottling associated with excess of boron and with chlorosis have not responded. Grapefruit, oranges, Lisbon, Villafranca and young Eureka lemons have all responded relatively quickly, usually in the first growth cycle after treatment, but old Eureka lemons have responded very slowly. Zinc sulphate-lime sprays have been tested at various concentrations, and the results suggest that, although dilute sprays may produce initial responses as great as stronger concentrations, their effect wears off more quickly. It appears that duration of response to zinc sulphate sprays is related to at least three factors:—(1) severity of the mottle-leaf, (2) the growth response resulting from treatment, and (3) the amount of zinc applied. In the trials described here, 4 oz. powdered blood albumin spreader per 100 gallons spray material resulted in better spreading and apparently in better sticking quality. Various other zinc sprays, including zinc oxide, compared on a basis of zinc content, have all given approximately equal initial responses, but have shown distinct differences in duration of the response. The effectiveness of dusts varied somewhat according to climatic conditions, but as with sprays the duration of the response is believed to be the most reliable criterion for comparisons.

* Part I appeared *Ibidem for 1934*, 1935, 31 : 98-107, *H.A.*, 1935, 5 : 2 : 268.

849. CLARK POWELL, H., AND MATHEWS, I. 634.3-2.19

The use of zinc sulphate in controlling mottle leaf of citrus trees.

Publ. Univ. Pretoria, 35 (ser. I), 1936, pp. 14, bibl. 1.

In experiments begun in 1933 on privately owned trees in the Sundays River Valley suffering from mottle leaf it was found that for bearing trees an application of 8 lb. of zinc sulphate placed in a narrow circular furrow 18-24 inches from the trunk and covered with soil had 2 years later reduced the 55-75% mottling to merely a trace. In certain cases, however, some damage was caused. Broadcasting zinc sulphate beneath the trees was ineffective. Spraying was then tried. A spray composed of 10 lb. sulphate of zinc, 5 lb. hydrated lime, 8-10 oz. spreader and 100 gallons water restored trees showing 55% mottling to health in a few months. The improvement in the root system of treated trees was most marked. Zinc sulphate spray should be given shortly before one of the periodic growth cycles begins, but not within two months of picking, as the residue is difficult to remove. The beneficial effects will probably last 2 years. The cost in S. Africa is from 1½d. to 3d. per tree according to size.

850. PITTMAN, H. A., AND OWEN, R. C. 634.3-2.4 + 2.19

Anthracnose and mottle leaf of citrus in Western Australia.

J. Dep. Agric. W. Aust., 1936, 13 : 137-42, bibl. 8.

Anthracnose (*Colletotrichum gloeosporioides*) is becoming of increasing importance in its attacks on citrus in Western Australia, causing defoliation and dieback and, in the case of Valencia oranges, mummification of the fruit on the tree through the killing of the fruit stalk. Control by spraying is ineffective and the main remedy would appear to be the building up of the health of the tree. Mottle leaf is also increasing and there is a strong suspicion that this is correlated with the increase of anthracnose. Chlorotic trees sprayed with 1% solution of chemically pure zinc sulphate had in a few weeks entirely lost their chlorosis and become normal in appearance, whereas the control trees remained unchanged. The importance is stressed of these results to certain districts in Western Australia on sandy or sandy loam soils where the trees become useless through chlorosis when 20 years old. Further experiments are in progress and recommendations for treatment on a commercial scale are deferred till these are completed. Meanwhile those wishing to experiment might use a zinc bordeaux mixture in which the bluestone is replaced by the same weight of commercial zinc sulphate and only half the normal quantity of quicklime is used.

851. PITTMAN, H. A. 632.1 : 634.3 + 634.22 + 634.11

Exanthema of citrus, Japanese plums and apple trees in Western Australia.

J. Dep. Agric. W. Aust., 1936, 13 : 187-93, bibl. 6.

Exanthema of citrus is shown in the early stages by the abnormally large and coarse foliage which develops on the water shoots and by the tendency of the latter to droop outwards and grow upward at the end forming an S-shaped curve. Young shoots develop blister-like gum pockets which later become longitudinal ridges exuding gum in winter. Affected shoots become defoliated and die back, while lateral growth from the base of dead twigs has a typically bunchy appearance. In lemons gum formation develops in the fruit rind and rarely on the branches. In Japanese plums cracking and gum exudation occurs along the bases of older branches forming forks, but not in the forks themselves, and there is considerable die-back. In Granny Smith apples a blistering of the bark on rapidly growing shoots has been assigned to the same category. The condition occurs on soils obviously deficient in humus. Control measures suggested are a good dressing of well rotted stable manure and cover cropping in winter. Experience has also shown that the following mixture by volume is effective for orange trees :—2½ parts superphosphate, 4 blood and bone, 1½ sulphate of ammonia, 1 sulphate of potash, applied at the rate of 1 oz. per square yard or 3 cwt. per acre. For lemons and deciduous fruits the mixture should be, 2½ parts superphosphate, 2 blood and bone, ¾ sulphate of ammonia, 1 sulphate of potash. Copper-containing sprays such as bordeaux mixture have given favourable results as has a dressing of 2½-3 lb. of finely powdered sulphate of copper applied to the soil in autumn shortly

after the beginning of the rains. The dressing should be given evenly, starting a foot beyond the radius of the branches.

852. BARNARD, C. 634.3-2.181

Citrus decline in the Murrumbidgee Irrigation Areas.

J. Council. sci. industr. Res. Aust., 1936, 9: 163-70.

This is an abbreviated form of a report of an investigation to discover the causes of the very high death rate of citrus trees in the Murrumbidgee Irrigation Area, which has become accentuated since 1931. The causes are diagnosed as waterlogging of the soil after high rains and heavy irrigation, assisted by certain other factors such as soil salinity and indifferent orchard management. There is evidence that an advisory campaign over the last 5 years, in which the importance of light irrigation and the dangers of a high water table have been stressed, has been effective and that acute waterlogging troubles will not re-occur. Severe heading back appears to be the most successful method of treatment for trees suffering from root injury.

853. PENMAN, F., AND PROVAN, J. L. 634.3-2.19

Defoliation of citrus.

J. Dep. Agric. Vict., 1936, 34: 279-84.

Defoliation of citrus in certain areas of N. Victoria has been traced to salt injury, due to soil salinity, faulty irrigation practice being a contributing factor especially with regard to too prolonged withholding of water. The furrow system of irrigation is condemned as tending to concentrate salt in the main root zones and at the bottom of irrigation runs where the most badly injured trees are nearly always to be found. The flood or the basin systems are preferable since with these the salt is leached away from the main root zones, particularly, as here, in the absence of a high water table.

854. KELLER, B. A. 634.3-2.111

Some characteristics of the winter stage of citrus trees. [Russian, English summary.]

Soviet Subtropics, No. 9 of 1936 (25), pp. 3-7.

Results of experiments lead the author to the following conclusions. Permanent coverings of mandarin trees in the field during winter are unsatisfactory, since they disturb the metabolism of the plant. Frost resistance can be increased by increasing the carbohydrate content and by instituting a special physiological condition which can be best done by careful manuring in winter so that nutrients can be assimilated without the trees being forced into growth, by creating an artificial dryness of the soil at the most dangerous periods, and by shading from direct sunlight during winter but without exclusion of light.

855. WEINDLING, R., AND FAWCETT, H. S. 634.3-2.48

Experiments in the control of *Rhizoctonia* damping-off of citrus seedlings.

Hilgardia, 1936, 10: 1-16, bibl. 32.

Acidifying the soil layers next to seed of several *Citrus* spp. by means of applications of aluminium sulphate or acid peat moss, so as to produce an initial reaction of about pH 4.0, successfully controlled damping-off of the seedlings, caused by *Rhizoctonia Solani*, in laboratory, glasshouse, and field experiments. On the other hand, where sterilized soils of the same acidity were inoculated with *Rhizoctonia*, damping-off was not controlled unless organisms of *Trichoderma* spp. were also present. The control of the disease by acidifying non-sterile soil is, therefore, considered to be due to a change in the microflora of the soil, favouring organisms such as *Trichoderma*, which may be antagonistic to or parasitic towards *Rhizoctonia Solani*, rather than to an unfavourable effect of acid media on the growth of *Rhizoctonia*. In soil of neutral reactions no biological control was exerted by *Trichoderma* spp. The effect of soil temperature was studied by growing seedlings at a series of 5 constant temperatures between 18° and 35°C. Neither the severity of the damping-off nor the degree of control obtained through applying aluminium

sulphate appeared to be affected by temperature. In conclusion, it is stated that aluminium sulphate seems a promising practical method for controlling damping-off of citrus seedlings. By comparison, peat, though again effective, had a stunting effect on most of the seedlings, while a 6% formaldehyde dust mixed into the upper 3 inches of soil 3 days before sowing, as recommended elsewhere, proved ineffective.

856. BATES, G. R. 632.48 : 634.3
Studies on the infection of citrus fruits. 1. Some methods of infection by the green mould, *Penicillium digitatum*, Sacc.
Annu. Rep. Mazoe Citrus Exp. Sta. for 1934, being *Publ. British South Africa Company*, 4, 1936, pp. 83-101, bibl. 11.

Previously* the author had shown that the oil vesicles provide a suitable avenue for infection by *Penicillium* and some further information on this point is given. Dry spore inoculation between the oil vessels is here shown to be ineffective, unless the wound penetrates to the inner pulp or rupture of oil vesicles occurs. Length of storage or normal ethylene colouring treatments do not impair this immunity. An inoculum of spores in water injected between the oil vesicles will, however, produce infection, resistance diminishing with the depth of the wound. Varietal differences in resistance to this form of infection exist. Inocula of spores in orange juice or in essential oil obtained from the rind completely break down resistance even with shallow wounds. Infection has also been produced with spores in water through the stem end of unwounded oranges: the exact point of entry has not been determined.

857. BAKER, R. E. D. 634.337-2.76
Root disease of the lime in Montserrat.
Trop. Agriculture, Trin., 1936, 13 : 147-8.

The present condition of lime cultivation in Montserrat is discussed. The most serious trouble is caused by the larvae of *Diapres* root-boring weevils. The outbreak has spread rapidly since 1933 and is now a menace to the industry. The symptoms of *Diapres* attack are described and distinguished from those caused by *Diplodia* dieback. Seedling and budded trees on any stock are apparently attacked indiscriminately, though it is suggested that stock trials might be undertaken. Entomological investigations are now in progress.

858. WINSTON, J. R. 634.323-2.48
A method of harvesting grapefruit to retard stem-end rot.
Circ. U.S. Dep. Agric., 396, 1936, pp. 8.

Stem-end rot of citrus is caused by either of the fungi *Diplodia natalensis* Evans and *Phomopsis Citri* Fawcett. It is probable that these organisms, which are prevalent in citrus groves on dead twigs, remain quiescent on the active tissue of the fruit stems but when the fruit is clipped they are able to advance into it. Under ordinary conditions about a week is needed for penetration into the fruit, and it is argued here that, if the fruit is pulled instead of clipped, the source of infection will be detached before it reaches the fruit. This does not apply to dead ripe fruit or fruit from unhealthy trees which may be already affected. Tests showed that the only citrus which could be pulled at marketing time with little injury to the rind was the grapefruit, and in fact the injuries resulting were less than those caused by clipper cuts and stem bruising in the normal method. Storage tests conducted during 3 seasons showed that pulled grapefruit was less rapidly affected by stem-end rot, and that the usual borax treatment for blue mould had also a deterrent effect on stem-end rot. Since, moreover, pulling is cheaper than clipping, and the trade readily accepts pulled grapefruit, the practice is recommended especially in the case of grapefruit intended for storage or export.

* Wastage during the 1932 export season. *Ibidem* for 1932, pp. 150-76, *H.A.*, 1933, 3 : 4 : 597 and *Oil glands of citrus fruits as an avenue of infection. Nature*, 1933, 132 : 3341 : 751, *H.A.*, 1933, 3 : 4 : 530.

859.

ANON.

634.3-2.4

La gommose parasitaire des aurantiacées. (**Parasitic gummosis of citrus.**)*Mémento Serv. Déf. végétaux, Rabat, Morocco, 35, 1935, pp. 7.*

An account is given of the symptoms of gummosis, which in Morocco is caused by *Phytophthora parasitica*, and of the life history of the fungus. Preventive control measures:—The sour orange, *Citrus Bigaradia* [syn. *C. Aurantium*—ED.], and the trifoliate orange, *C. trifoliata*, are resistant, though not immune, to gummosis. They may be used as rootstocks, budding being done high so that the stock may provide almost the whole trunk. The deciduous nature of the trifoliate orange has, however, the effect of slowing down the growth of the scions during winter and in addition it is incompatible with lemons. The citron and sweet orange should never be used as stocks in plantations. To avoid contact between the trunks and moist soil, basin irrigation should always be avoided, and water should be applied in furrows at least 1 metre from the trunks. Earthing up around the trees, especially on heavy soil, is not recommended. As the development of gummosis is encouraged by nitrogenous fertilizers, farmyard manure should not be placed in the planting holes and should subsequently be applied sparingly. Phosphatic manures, on the other hand, are beneficial. Curative measures:—Where a tree has become infected, the base of the trunk should be laid bare down to the root junctions, and the diseased bark cut away with a sharp gouging instrument to a depth of 2-3 cms., care being taken to cut well into the clean wood at the sides of the lesion. The wound should then be painted with strong bordeaux mixture consisting of 5 kilos copper sulphate, 10 kilos chalk to 50 litres water. Profuse gumming generally follows, but the wound should be left untouched for at least a fortnight to see if it heals properly. When healed and the gummosis has not reappeared at the sides of the wound, it should be dressed with suitable preparations of asphalt or tar. Growers are reminded that after the use of bordeaux mixture mineral oil sprays should not be applied for at least 2 months and fumigation with hydrocyanic gas should not be carried out for 6 months. Where gummosis has become very severe the only way of saving a tree is to inarch two or more young sour orange stocks to the principal branches.

860.

UPPAL, B. N. AND KAMAT, M. N.

634.3-2.411

Gummosis of citrus in Bombay.*Indian J. agric. Sci., 1936, 6 : 803-22, bibl. 9.*

In India gummosis is widespread in the orchards of Bombay-Deccan particularly on mosambi, an Indian variety of *Citrus sinensis* Osbeck. In this paper the fungus responsible is said to be *Phytophthora palmivora* Butler in the "rubber" group of that species and it is compared with *Phytophthora citrophthora* and *P. parasitica*, the cause of gummosis in other countries. Experiments in relative resistance of different citrus species in India show the high susceptibility of grapefruit and sweet orange and the practical immunity of the kagdi lemon (*C. aurantifolia* var.) and jamburi (*C. Limonia* var.). Santra (*C. nobilis* Lour. var. *deliciosa* Swingle), the common mandarin, occupies an intermediate position. Sweet orange grafted on jamburi is immune. Soil and irrigation water should be kept away from the bud union, this being a favourite spot for the entry of the fungus. Trials with fungicides bring out the high fungicidal value of creosote. The bark round the diseased portion should be removed and the wound covered with creosote oil. It may be then painted with coal tar.

861.

SMITH, F. E.

634.3-2.4

Wither-tip or anthraenose disease of citrus trees.*J. Jamaica agric. Soc., 1936, 40 : 50-2.*

Wither-tip disease in Jamaica is often associated with the fungus *Colletotrichum gloeosporioides*. The fungus, however, is not very vigorous and attacks only already debilitated trees, in fact wither-tip can appear without any fungus in the early stages. It is most frequent on young trees from 1-5 years old when there is some incompatibility of stock and scion as regards vigour or when cultural conditions are adverse. The application of copper sulphate to the soil has

overcome the tendency to wither-tip in other countries and is being tried experimentally in Jamaica.

862. CARMIN, J.

634.3-2.752

Do fungi help to exterminate red scale in Palestine?

Hadar, 1936, **9**: 173-5, bibl. 6.

Observations in two groves have indicated that red scale, *Aonidiella* (*Chrysomphalus*) *aurantii*, on citrus fruits is attacked by several fungi. The fact that red scale is rarely a serious pest in older groves is generally attributed to the existence of more favourable breeding conditions for ladybird predators (*Chilocorus* sp.), but, in view of the results of these observations, it is now thought probable that older, densely planted groves may provide better conditions for the development of parasitic fungi, and that this factor, combined with a reduction in old trees of the supply of foods suitable for the scale insects, is responsible for the lighter infestations. Fungi so far isolated from red scale have been identified as *Aspergillus depauperatus* and another *Aspergillus* sp., *Cladosporium herbarum* and *Dematium pullulans*, the last two of which are believed to be forms of the same fungus. Further investigation is, however, necessary before the pathogenic value of each of these species can be assessed.

863. HAYWARD, K.

632.752 : 634.3

La cochinilla blanca de los *Citrus* y su control. (White scale of citrus and its control.)

Circ. Exp. Sta. Concordia, Argentina, **9**, 1936, stencilled, pp. 4.

The pest (*Prontaspis citri* Comstock) is almost universal in the citrus groves of the Argentine and does a great amount of damage. The life history of the insect is described. The most effective treatment in the event of a severe attack is to spray the trunk and wood of the main branches with a 2-2½% mineral oil emulsion, then 15 days later to spray the whole tree at a strength of not less than 1.7%. In light infestations one spraying at the lower strength is adequate. Pump pressure is important, since it has been found that 2% oil emulsion at 150 lb. pressure is more effective than a 3% oil emulsion at 80-100 lb.

864. BARTHOLOMEW, E. T., AND RABY, E. C.

634.3-2.944

The recovery of hydrocyanic acid from fumigated citrus leaves.

J. biol. Chem., 1936, **113**: 655-60, bibl. 6.

In attempting to measure by recovery the amount of HCN absorbed by mature leaves of *Citrus sinensis* Osbeck during fumigation, it was found that HCN could not be recovered by the acid distillation method, because it combined with some substance or substances in the distillate. Only when HCN was added much in excess of that which the leaves would be expected to absorb during fumigation, could any be detected in the distillate. It is, therefore, concluded that at least a portion of the HCN which enters the living citrus leaves is quite rapidly and permanently fixed. There is some evidence that the aldehydes, sugars or citral are not entirely responsible for the disappearance of such large quantities of HCN, and it is also pointed out that citrus tissues do not contain cyanophoric glucosides, which have been associated with the disappearance of HCN in tissues of certain other plants. The determinations of HCN in solution described in this paper were very satisfactorily made by means of a Weston photronic, photo-electric turbidimeter, specially devised and constructed for the purpose.

865. SMITH, R. H.

632.752

Pyrethrum extract tested on red scale.

Calif. Citrogr., 1936, **21**: 287.

Experiments in field and laboratory confirm results of earlier experiments and seem to show conclusively that pyrethrum is not particularly toxic to red scale of citrus in California.

866. PIERES, R. B. 634.3-2.952
Aceites emulsionables para la pulverización de citrus. (*Citrus spray emulsions.*)

Circ. Exp. Sta. Concordia, Argentina, 10, 1936, pp. 10.

The chemistry of oil sprays is briefly discussed and the qualities which the various ingredients must possess to be effective are mentioned. The local citrus growers prefer to buy proprietary spray emulsions either local or imported, but it has been found that these deteriorate rapidly in the climate and furthermore that their action is not uniform for all districts either as regards destruction of pests or spray injury. It is urged that it is much safer and cheaper for growers to mix their own ingredients and a useful formula is given—mineral oil 38 litres, water 10 litres, casein 375 grammes, ammonia 100 cubic centimetres. This is used with water in the proportion of 1:50 if the treatment is applied early, but may be strengthened up to 1:33, if infestation is pronounced.

867. NOBLE, N. S. 634.3-2.79
The citrus gall wasp (*Eurytoma fellis* Girault).

Sci. Bull. Dep. Agric. N.S.W., 53, 1936, pp. 41, bibl. 10.

A detailed account is given of the morphology and life history of the gall wasp, which may attack all varieties of citrus, particularly lemons. It occurs in the coastal districts of Southern Queensland and Northern N.S.W. Control measures consist in the systematic removal and destruction of galls during the winter months.

868. LACARELLE, F. 634.1/7
L'experimentation fruitière et maraîchère au Maroc. (**Experimental work on fruit and market vegetables in Morocco.**)

Reprint from *C.R. Congr. Hort. Casablanca*, 1936, pp. 13.

A progress report is given of the horticultural experimental work which was started in Morocco about 2 years ago. Although the experimental plantations have not long been laid out, the influence of soil, climate and rootstock is already becoming apparent and in oranges especially the importance of bud selection is obvious. There are several stations and between them the following subjects are being studied:—rootstock and scion relations in apricot; double working, bud selection, manual experiments and irrigation of oranges; rootstock trials with all tree fruits of local importance; vegetative propagation methods; pollination studies. Processing of fruit is undertaken with a view to finding the most suitable varieties for canning and drying.

869. POPENOE, W. 634.653
Origin of the cultivated races of avocados.

Yearb. Calif. Avocado Ass. for 1935, 1935, pp. 184-94.

In this interesting article the author discusses the geographic distribution of the avocado and the nomenclature of the cultivated races. He regards all the cultivated types, Mexican, Guatemalan and West Indian to be forms of a common species, *Persea americana* Mill, formerly known as *P. gratissima*, and attempts to show that they are in all probability derived from prototypes which still exist in a wild state in tropical America. In the course of his travels he has encountered four types which are here described briefly with the help of photographs. The neighbourhood of the volcano Orizaba in Mexico appears to be the native home of the Mexican race, the trees in this locality apparently differing from cultivated varieties only in size of fruit. In the Tecpan region of Guatemala, at altitudes of 8,000 to 9,000 feet, another form resembling the cultivated Guatemalan varieties in all but size of fruit has come to light. The so-called wild avocado of San Isidro is a third form of *P. americana*, indigenous from Honduras to at least as far south as Costa Rica. It differs considerably from the West Indian types, but its geographical distribution suggests that it is the parent of this race. On the other hand avocados typical of West Indian types in form and character, though smaller, have been found in the

region of Santa Marta in Colombia. They are possibly escapes, but the author inclines to the opinion that they represent a truly indigenous form. If this is so, they are undoubtedly the wild prototypes of West Indian varieties, and the San Isidro avocado simply takes its place as a geographical form of *P. americana*, but one which has not contributed to the development of present-day horticultural varieties.

870. MARSH, R. H. 634.653 : 581.14

Rate of growth of Fuerte fruit.

Yearb. Calif. Avocado Ass. for 1935, 1935, pp. 89-91.

Measurements of Fuerte avocado fruits over a 3-year period have shown that the fruit increases rapidly in size from July to October, grows more slowly from November to January, and then with the advent of warmer weather begins to grow rapidly again until almost ready to drop. From this the author concludes that, although a higher price is obtained for early picked fruit (October-November), growers should give serious thought to the additional weight of fruit obtained by delaying harvesting until late winter or early spring.

871. BARRETT, C. 634.653-1.542

Training and pruning avocado trees.

Yearb. Calif. Avocado Ass. for 1935, 1935, pp. 98-103.

The training and pruning of avocado trees is discussed in relation to environmental and cultural conditions, and the author offers suggestions to growers based on his own experiences.

872. HAAS, A. R. C. 634.653-2.19

Accumulations of salts in the tips of avocado leaves in relation to tip-burn.

Yearb. Calif. Avocado Ass. for 1935, 1935, p. 105.

A table is presented which shows that even in healthy avocado leaves dry matter, which includes salts, normally accumulates more rapidly in the tip than in the stem half. Thus, when chlorine comprises a considerable part of the dry matter, "burning" first occurs near the tip and spreads progressively towards the stem end.

873. HODGSON, R. W., AND CAMERON, S. H. 634.653-1.55

Studies on the bearing behaviour of the Fuerte avocado variety.

Yearb. Calif. Avocado Ass. for 1935, 1935, pp. 156-65, bibl. in text.

From an analysis based on records of yields and of mean temperatures during the January to March period over 8 years the following conclusions are drawn :—(1) That the amount of crop produced the previous season is the causal factor in the pronounced alternate bearing tendency of the Fuerte avocado variety in S. California. (2) That mean temperature conditions during the bloom period comprise an important factor in the bearing behaviour of this variety. (3) That the alternation may be thrown out of step by two successive bloom periods of above or below average temperature. Experiments are also being carried out to determine possible means of influencing or controlling bearing behaviour. Preliminary results are here discussed. Girdling limbs in the early part of the bloom period has been successful in causing non-productive trees to bear, but when tried on a limited scale in November and March for the purpose of regulating alternate bearing it has given inconclusive or negative results. Experiments on the effect of early harvesting (November) as opposed to late (March) have given results which suggest that this may prove a practicable means of regulating blossoming and bearing behaviour. In certain instances where early harvesting led to excessive blooming, the adjacent foliage was a pale colour and possessed a much reduced nitrogen content. Fertilizing with nitrogen and phosphates has so far had no effect on bearing. Experiments on fruit thinning are also in progress, but no data have yet been obtained.

874. HODGSON, R. W., AND CAMERON, S. H. 634.653-1.55
Temperature in relation to the alternate bearing behaviour of the Fuerte avocado variety.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 55-60, bibl. 2.

Evidence collected in 5 orchards in California over a period of 5-12 years indicates that there is a definite biennial bearing tendency in the Fuerte avocado variety, and that the final crop is largely influenced by temperature during the blossoming period. The interrelationship of these two factors is discussed.

875. MARSH, R. H. 634.653-1.8
Fertilizer trials on the Fuerte avocado. A progress report.
Yearb. Calif. Avocado Ass. for 1935, 1935, pp. 118-9.

The trees were 5 years old at the outset of the trial, and were growing on a residual medium clay loam soil. Of 4 treatments tested the application of 2 lb. nitrogen per tree alone and in addition to 10 tons stable manure per acre produced yields over a 4-year period more than twice as high as those produced by stable manure alone or no manure. The returns after deducting costs also show marked differences in favour of the use of 2 lb. nitrogen per tree.

876. SCHROEDER, C. A. 634.653-2.8
Effects of sun-blotch on the anatomy of the avocado stem.

Yearb. Calif. Avocado Ass. for 1935, 1935, pp. 125-9, bibl. 3.

Sun-blotch is a virus disease, restricted in distribution almost entirely to California. An outline is given of its external symptoms, and differences in the anatomical structure of normal and sun-blotch-affected stems of *Persea drymifolia* are then described with the aid of diagrams. Preliminary studies show that in general the most prominent anatomical difference is to be found in the vascular tissue of diseased stems. Associated with the external symptomatic groove on the stem there is relative lack of development and differentiation of the xylem and phloem tissues. In a number of specimens it was found that xylem elements below the groove were replaced by modified parenchyma cells. The position of these cells indicated that a group of normal xylem cells was first laid down, followed by a group of modified cells and later by a second group of normal cells, from which it appears that the virus is intermittent in its effect upon the differentiation of the tissues. Other differences in diseased stems, such as reduction in the number of cortex cells and the presence of phloem lesions in some cases, are also noted. The principal conclusion reached is that the virus is closely associated with the cambial activity of the plant stem and results in abnormal production and differentiation of vascular tissue.

877. COIT, J. E. 634.653 : 658.8
Marketability of avocado varieties.

Yearb. Calif. Avocado Ass. for 1935, 1935, pp. 59-64.

Specifications to which the ideal avocado fruit would conform are summarized as follows:— (1) Size, 6 to 12 oz. (2) Shape, typically pyriform. (3) Colour, dark green. (4) Seed, less than 12% of the fruit, tight and with seed coats adhering to seed. (5) Skin, medium thin, tough and with a smooth surface, yielding when softening. (6) Flesh, oil content 16 to 22%, free from fibre, deep yellowish green. (7) Flavour, rich and nutty, free from sweetness, bitterness or soapiness. (8) The fruit must have the quality of remaining good inside until such a time as final decomposition is quite apparent outside. (9) Evenness of maturing and softening over all parts of the fruit. (10) Long keeping qualities in both common and cold storage. (11) The cut surface should remain bright and attractive for several hours. These specifications apply particularly to California avocado varieties, and the author suggests some of them, e.g. dark green colour, with a view to making local fruits as distinctive as possible from imported types. The Fuerte is the variety most nearly conforming to the specifications given.

878. PALMER, D. 634.653-2.1/4
Practical methods of disease control in avocados.
Yearb. Calif. Avocado Ass. for 1935, 1935, pp. 72-80.

This paper was presented at the Avocado Institute, La Habra, California, and was followed by a general discussion (pp. 77-80). Control measures, based on experimental results, are outlined for the following diseases:—*Dothiorella* rot, tip-burn, lime chlorosis, cankers, little-leaf, sun blotch and oak root fungus.

879. COIT, J. E. 634.653-2.944
Effects of vacuum fumigation on avocado scions.
Yearb. Calif. Avocado Ass. for 1935, 1935, p. 49.

When the ends of scions of the variety Edranol were dipped in bituctet [presumably a proprietary type of bituminous pitch or emulsion.—ED.] and dried prior to vacuum fumigation with hydrocyanic acid gas, the grafts grew approximately as well as fresh scions when both were interset on the same stumps.

880. ILYASHENKO, K. 633.85 : 581.144.2
Root development of the tung tree. [Russian, English summary.]
Soviet Subtropics, No. 2 of 1936 (18), pp. 14-7.

Deep planting in the case of the tung tree gives it greater stability and greater powers of utilizing moisture. In such deep planting the existing roots continue to develop normally, while additional roots emerge above the root crown. An increase in planting depth of 10 cm. increased the average growth of the plants by 12.5%. Erosion on tung plantations may be prevented by leaving most of the plantation under sod and cultivating only round the trees. By concentrating the fertilizers only in these cleared spaces the root development may concentrate there also.

881. CHKHIKVISHVILI, V. 633.525.1
Some results of ramie fertilization in the Alazan valley. [Russian, English summary.]
Soviet Subtropics, No. 10 of 1936 (26), pp. 30-5.

It is proved by the success of its cultivation in Alazan Valley, Eastern Georgia, that ramie (*Boehmeria nivea* Hook.) can be successfully grown on heavy salt loams as well as on the light sandy soils hitherto considered essential. The plant is a gross feeder so that, however fertile the soil, heavy dressings of fertilizer must be applied. When this has been done an increase of yield up to 400% has been obtained. As the feeding roots of ramie are concentrated in the second sub-horizon it is suggested that the manure should be turned under the soil to a depth of 10 cm. and that it should not be mixed with the upper layer.

TROPICAL CROPS.

882. CHEESMAN, E. E., AND SPENCER, G. E. L. 631.535
The propagation of cuttings in tropical climates.
Trop. Agriculture, Trin., 1936, 13 : 201-3.

The advantages of soft- or semi-hardwood cuttings in preference to hardwood are pointed out. A propagating frame is necessary and those in use at the Imperial College of Tropical Agriculture are described and illustrated. The temperature question is not a matter of concern in the tropics, but the problem is to control the water balance and to maintain a practically saturated atmosphere within the frames, while providing the correct amount of light, which must not be sufficiently strong to raise the temperature and increase transpiration or weak enough to retard photosynthesis. The degree of shade required for any particular species can only be discovered by trial and error, but the optimum for *Theobroma Cacao* seems to suit the majority. Empirical observations show that soft wooded material responds best when taken at the conclusion of

a flush, when the leaves are fully expanded but not soft. The most suitable rooting medium is a coarse grained calcareous sand, but *Citrus* spp. have consistently given better results in a finer sand. Leaf abscission when not due to over shading or insect attack is probably caused by a failure to take up moisture from the cut end possibly owing to an air lock. This can be guarded against by placing the cuttings in water immediately they are taken and taking them only at a time when their turgor is high. If, as softwood cuttings usually do, they root before making leaf growth they can be planted out without a preliminary hardening off, but excessive transpiration must be guarded against until plants are established.

883. CEYLON, DIVISION OF MYCOLOGY. 632.3/4 : 014

A list of the diseases of cultivated plants in Ceylon.

Bull. Dep. Agric. Ceylon, **88**, 1936, pp. 47.

The plants are listed in alphabetical order according to their specific names, and under each the diseases are similarly listed in groups such as root diseases, stem diseases, etc. Lists are also given of botanical equivalents for the English, Sinhalese and Tamil names of plants, and in an appendix there is a list of plants attacked by three eelworms.

884. TATTERSFIELD, F. 632.951.1

Fish poison plants as insecticides.

Emp. J. exp. Agric., 1936, **4** : 136-44, bibl. 45.

This is a review of recent work and is concerned chiefly with those species of *Derris*, *Lonchocarpus* and *Tephrosia* which are used in tropical countries for stupefying fish. The results of research are dealt with under the heads—nomenclature, active principles, chemical evaluation, effect of genetical and environmental factors, cubé, haiari and timbó, *Tephrosia* species, chemical structure, toxicity to insects, physiological action and loss of activity.

885. WOOD, R. C., AND JAMES, H. M. 635.35

Cauliflower cultivation in the tropics.

Trop. Agriculture, Trin., 1936, **13** : 218-20, bibl. 4.

An account is given of trial plantings of Early Patna cauliflower in Trinidad. The seed was an Indian-grown strain and Messrs. Sutton & Sons, who supplied it, think that originally it was a selection from their Improved Snowball. Other successful strains reported to be satisfactory in the West Indies are Main Crop Patna and Early and Main Crop Benares in British Guiana, and Early Market in Barbados. The seasonal limitations have not been defined, but it is evidently a crop for the cooler season. The average weight of heads was 1½ lb., though heads of up to 4 lb. were obtained. Apart from ordinary cultural attention it was found that the colour was improved by skewering 3 or 4 leaves together to shade the flower and that heads should be cut the day they are ripe. Cool storage up to 40 days has been found possible (*Trop. Agriculture, Trin.* 1934, **11** : 199). The life history and control of a serious caterpillar pest (*Heliothis phidoleasis*) are described. It is stated that the pest can ruin the entire crop. The possibilities of the crop for export purposes are discussed.

886. TERRA, G. J. A. 635.25

Uienteelt in de tropen. (**Onion growing in the tropics.**) [Dutch, English summary.]

Landbouw., 1936, **12** : 117-32, bibl. 23.

The tropical and sub-tropical countries in which the true onion *Allium Cepa* L. is grown are enumerated. Some of these have climates very similar to Java, yet in Java the shallot, *Allium ascalonicum* L., has hitherto alone succeeded. However, recent experiments in which certain conditions were provided have given much improved though somewhat irregular results. These conditions are a fertile, deep, friable soil, heavy watering (rain or irrigation) just before or during growth, and a dry period for harvest. The usual method of propagation in the tropics is by transplanted seedlings.

887. DALGANO, W. T. 635.64

Tomato cultivation in the Bahamas.

Trop. Agriculture, Trin., 1936, 13 : 175-6.

Canada is the sole outlet for Bahamas tomatoes since the closing of the U.S.A. markets. The variety preferred for this trade is Globe, which through rigid selection has reached a high stage of perfection in yield, quality and carrying powers. The soils are of 3 types, red loam, sandy or white, and black, the last being the best. It does not pay to work them for more than 2 successive years. The fertilizer most used, which has been built up by American chemists after careful analysis of the soils, is $N\ 5 : P_2O_5\ 7 : K_2O\ 5$ derived from dissolved bones, nitrate of soda, sulphate of ammonia, cotton seed meal, H.G. tankage and German sulphate of potash, used at the rate of 800-900 lb. per acre and applied in 2 dressings. The remainder of the article is concerned with the adaptation of cultural methods to local conditions.

888. GEORGI, C. D. V., AND OTHERS. 632.951

Preliminary selection experiments with derris.

Malay. agric. J., 1936, 24 : 374-92, bibl. 4.

A comprehensive survey of the principal *Derris* species grown in Malaya has been made and clonal plantings have been established at Serdang on 2 different soils for further trial in an attempt to develop types with a high toxic content. The lack of standardization in quality affects the development of derris as an insecticide and the industry now has to face increasing competition from the (S. American) cubé root (*Lonchocarpus* sp.). Some 7 varieties are dealt with and details of the experimental work with each are given.

889. MILSUM, J. N. 632.951

Derris cultivation in Perak.

Malay. agric. J., 1936, 24 : 390-2, bibl. 3.

A note on the local methods of growing and marketing derris. The species grown has been identified as *D. malaccensis* Prain and it is referred to here as *D. malaccensis* Kinta type, as it differs in certain respects from the type. The rotenone content is very low, being about 0.2%.

890. MAAS, J. G. J. A. 632.951.1

De cultuur van derris-wortel. (Cultivation of derris.)

Reprinted from *Bergcultures*, Nos. 42/47, 1935, pp. 53, bibl. 275.

This is a full account of the cultivation, export and uses of derris, more particularly in the Dutch East Indies. Considerable attention is paid to improved varieties, having a higher rotenone content than any varieties hitherto produced, which are being raised in Java and Sumatra. [The portion dealing with the new varieties, the method of finding high rotenone-containing plants among the peasant growers' stocks and of the rapid propagation of these plants when found has been translated and is available *on loan*.—ED.]

891. BARRETT, O. W. 632.951

Note on the vegetative propagation of derris.

Trop. Agriculture, Trin., 1936, 13 : 149-50.

Cuttings can be made of 2 or preferably 3 nodes in length. In young wood the cuts should be made close to the joint at either end of the cutting, as its jelly-like pith shrinks or rots down to the node. In old wood the cuts may be made anywhere, since the roots start from lenticel-like pustules at any point. In packing cuttings for transport the cutting ends should be bedded in dampened sphagnum or peat; this induces callusing, prevents mould and even allows of slow sprouting and rooting during transit. Packed thus the cuttings remain viable for 6 or 8 weeks. While other moisture-holding packing material may be used, leaf mould should be avoided as it often causes fungal attack. It is advisable to provide ventilation holes in small parcels. Freshly made cuttings should always be kept in moist wrappings for a week or more to induce callus

formation before planting. Cuttings which on receipt show signs of growth of root or bud may be planted in their permanent positions ; if less advanced or if the field is not ready, they may be stratified in wet sphagnum or other porous material. Precaution should be taken against damping or drying out. If it is necessary to plant cuttings before shoots or roots have started, sand should be placed round the butt which should be about 4 inches below the surface, leaving 2 inches above the ground. The above-ground portion should be protected by wrapping in sphagnum or by a covering of grass or straw. The author advises that a modification of the layered ridge-trench method of planting used at the Agricultural Experiment Station, Puerto Rico, be employed. This enables a root crop to be taken without undue disturbance and also encourages rapid rootgrowth. It consists of a trench 2 ft. wide and 18 in. deep filled nearly to the surface with alternate layers 3-4 in. deep of mulch or stable manure and soil. A layer of stable manure, ashes or some slow fertilizer completes the filling to ground level and the trench is then ridged up to a foot above the original soil surface. The finished ridge should be 3 feet wide through the centre and 2 feet at the top. Cuttings are planted about 18 in. apart diagonally across the ridge top. The ridges should be 6 feet apart.

892. TOXOPEUS, H. J. 633.513 : 551.577
 Over den invloed van den regenval op de periodiciteit en de dracht van kapok. (**Influence of rainfall on the periodicity and yield of kapok.**)
 Reprinted from *Verslag v.d. 15e vergadering v.d. vereniging van proefstation-
 personeel te Batavia*, Oct. 1935, pp. 83-98. (Proceedings of 15th research-
 workers' conference at Batavia.)

An analysis of records of rainfall, time of flowering and yield of kapok seems to show that early onset of rains following the dry season, at which time the tree is about to come into leaf after fruiting, results in an early flowering and harvest the subsequent season, whereas, if the rains are delayed, the crop also is late. The period at which the rains cease seems to be immaterial. The explanation given is that the tree has to accumulate a certain amount of reserve nutrient before the leaves can drop and the flowers appear, and requires a certain time in which to do it. It flowers in a leafless condition during the dry season. Lack of moisture delays the start of assimilation and so retards the time of harvest. The harvest is also delayed and the yield reduced, if the rainfall during the dry season preceding the harvest is poor. On the other hand excessive rain during the dry season causes premature fruit drop owing to the leaves starting to grow. Discussing the rainfall requirements of kapok it is shown that the districts in which kapok is most frequent are those having a pronounced dry season—including only 10-25 days on which rain falls—and a total fall of 200-350 mm. during the 4 months of its duration. The total annual rainfall should be from 1,800 to 2,000 mm.

893. EVANS, H. 633.61 : 581.144.2
The root system of the sugar-cane. II. Some typical root systems. III. The early development of root systems in Mauritius.
Emp. J. exper. Agric., 1936, 4 : 208-20*, 325-31.

II. An account, with illustrations, is given of the root systems of a number of sugar cane varieties in Mauritius. From the type of root system it is possible to select varieties capable of doing well in any particular soil environment such as wet soil, a dry soil or one infested with the root-eating grubs of *Phytalus smithi*. Fertilizer programmes and cultural treatments can be evolved from data provided by the root systems and the degree of cyclone resistance can also be estimated. III. As a result of a study of the rooting habits and some preliminary experiments it is suggested that fertilizer should be spread evenly over the field and not in concentrated masses in the middle of the clump as at present. Roots of cane seldom occupy the superficial soil layer (2-3 inches down) unless the leaves have closed over the interline between rows, and accordingly, for full benefit to be obtained, fertilizers should be turned in to the requisite depth after broadcasting. Experiments in subsoiling and in placing manure at the bottom of the

* Part I., *Ibidem*, 1935, 3 : 351-62, *H.A.*, 1935, 5 : 4 : 689.

hole in the case of new plantings for the benefit of the buttress roots, which otherwise are difficult to reach, have so far indicated that these methods produce an increased growth, a greater resistance to drought, to high winds and to heavy *Phytalus* infestation. *Phytalus* grubs mainly occupy the first foot of soil and in addition many would be killed by the subsoiling operation. The system of manuring in which trenches are cut near the stool and filled with manure should be carried out early. Postponement until the plants are 3 or 4 months old results in damage to roots and a possible set back in dry weather.

894. SAYER, W., AND IYER, P. V. K. 633.61 : 581.084.2
On some factors that influence the error of field experiments with special reference to sugarcane.
Indian J. agric. Sci., 1936, 6 : 917-29.

It is shown that error of field experiments is partly governed by size and shape of plots. In these experiments in which the cane plots were normally 1/242nd acre or 60 ft. × 3 ft. each, it was found that percentage variation can be diminished by increasing plot size up to 9/242nds or 1/27th acre. Theoretically nothing is to be gained by increase beyond this size, but if convenient the size of plots can be increased to 15/242nds or 1/16th acre. In the matter of shape the error can be diminished slightly by increasing the ratio of length to breadth up to a limit of 30, but between 5 and 15 is usually the more convenient. 6 to 9 replications are enough.

895. GOLDING, F. D. 633.682-2.8
***Bemisia nigeriensis* Corb., a vector of cassava mosaic in Southern Nigeria.**
Trop. Agriculture, Trin., 1936, 13 : 182-6, bibl. 6.

A series of transmission experiments with adult *Bemisia nigeriensis* Corb. proved this species to be a vector of cassava mosaic. A full account of the experiments is given. The most resistant varieties of cassava had each a purple colouration of the petiole. Of the 10 most susceptible varieties 5 had green and 5 purple or purplish petioles.

896. GOLDING, F. D. 633.682-2.8
Cassava mosaic in Southern Nigeria.
Bull. Agric. Dep. Nigeria, 11, 1936, pp. 1-10, bibl. 8.

Cassava mosaic appears to be widespread in west and equatorial Africa. Transmission experiments were made with an Aleurodid, *Bemisia* sp., which is the only insect abundant on cassava in south-western Nigeria, but the results were negative [see, however, 895 above. ED.]. The effect of mosaic on yield was studied in two-branched plants. Where all the leaves showed mosaic, yields were reduced by about 30% compared with those of healthy plants. Where the leaves on one branch only showed mosaic, yields were not reduced, which pointed to infection being of recent occurrence. Two healthy introduced varieties grown in plots with infected local plants, gave yields 2 and 4 times as great as those of the local plants, but 88% of one variety and 42 to 59% of the other developed mosaic within 4 months of planting.

897. EDEN, T. 633.72
Report on a visit to the tea districts of North-East India, 1935.
Bull. Tea Res. Inst. Ceylon, 14, 1936, pp. 42.

An account of a visit to the tea districts of North-East India and to the Tocklai Tea Research Station, Assam, by the Agricultural Chemist of the Ceylon Tea Research Institute. A description of the districts visited is given with some account of their peculiar characteristics, followed by a consideration of the standard processes of cultivation and manufacture adopted in these districts. Comparison with Ceylon tea planting practices are freely made. The work at Tocklai was thoroughly studied and certain experiments of interest to Ceylon planters are described.

898. POKROVSKY, W. N., AND MERABIAN, S. G. 633.72 : 612.014.44
Photoperiodism and growth of the tea plant. [Russian, English summary.]
Soviet Subtropics, No. 11 of 1936 (27), pp. 37-55.

Chinese-Indian tea hybrids, hardy in U.S.S.R. which had never fruited, and non-hardy South Indian varieties, which as a rule do not flower in Russia, were stimulated into fruitfulness by reduction of the day length to 10 hours (some of the S. Indian varieties were unaffected and these require some other light treatment). The result of this reaction is that for the first time crosses between southern and northern forms have been possible in U.S.S.R. Vegetative processes, however, were unaffected by the altered light period.

899. JANASHIYA, A. L. 633.72 : 581.144.2
Root development of the tea plant. [Russian, English summary.]
Soviet Subtropics, No. 4 of 1936 (20), pp. 41-6.

An account is given of the effects of the different types of W. Georgian soils on the root systems of the tea plant. The soils are classified as red soil, podsolized soils, slightly podsolized soils and alluvium. The latter, when there is a sufficient humus content, is considered to be the best medium for root development. There are some good diagrams of rootgrowth.

900. TUBBS, F. R. 633.72-1.542-2.112
Drought and pruning.
Tea Quart., 1936, 9 : 25-9.

The effects of drought on the tea plant are discussed. The only practical method of reducing water loss is by pruning, but this must be regarded as a method for severe conditions only. Pruning in general is dealt with. The best pruning is that which results from a definite purpose or plan and the following objects should be kept in view :—(1) The maintenance of a height that will permit of easy plucking, (2) the application of a stimulus to more vigorous production of leaves and shoots, (3) maintenance of the frame in a healthy condition, (4) utilization of the acreage available. The author discusses the best way of achieving such results.

901. GIGIBERIA, S. L. 633.72-1.55
Mechanization of tea leaf plucking. [Russian, English summary.]
Soviet Subtropics, No. 3 of 1936 (19), pp.10-5.

The author describes and illustrates photographically a tea leaf plucking machine of his own construction. Tests show that the efficiency of plucking [presumably in terms of speed.—ED.] is 5 times as great as hand plucking and twice as great as clipping with shears, the quality of the leaf being equal to or slightly higher than that of tea clipped with shears. The machine, which cuts on the same principle as a multiple toothed hair clipper, runs along the top of the continuous knee-high hedge of tea. The question of power for propelling the machine remains. At present it is pushed by hand and requires two persons, one on either side of the row.

902. POPOV, I. F. 633.72-1.55
Tea leaf plucking mechanization. [Russian, English summary.]
Soviet Subtropics, No. 2 of 1936 (18), pp. 30-42.

Trials of a number of tea plucking machines constructed by the Soviet Research Institute for the Mechanization of Agriculture and by private individuals are reported. The machines include segmental cutters and band, disc, sickle-shaped, oscillating, rotary breaking and picking devices. Of these the segmental cutters (Lida and others) gave the best results. The machines are not perfect and further research is advocated, in the course of which it is suggested that a study of the entire complex of the tea plant should be made.

903. BRADSHAW, R. G., AND YUILLE, H. B. 633.72
A glossary of tea tasters' terms.
Tea Quart., 1935, 8: 183-7.

A list and explanation is given of the various terms in daily use in the London tea market. They are classified under terms used to describe the character of (1) dry leaf, (2) infused leaf, (3) liquor and (4) general characteristics. [A glossary of tea tasters' terms used in Ceylon appeared *Ibidem*, 1934, 7: 129-33, *H.A.* 1934, 4: 4: 683.]

904. GADD, C. H. 633.72-2.4
Diseases of the tea bush.
Tea Quart., 1935, 8: 132-9, 1936, 9: 5-12, bibl. 2.

Part I. Diseases in general and fungi in particular. A general account is given of the biology of parasitic fungi and the part they play as causative factors of plant disease. *Part II. Root diseases.* The general symptoms of root diseases are described, of which the sudden death of an apparently healthy plant is one of the most usual. A general discussion follows in which some consideration is given to red root (*Poria hypolateritia*), black root (*Rosellinia arcuata*), brown root (*Fomes lamaoensis*), charcoal root rot (*Ustilina zonata*), bootlace fungus (*Armillaria mellea*).

905. CORBETT, G. H., AND MILLER, N. C. E. 632.732: 633.72
The termite, *Microtermes pallidus* Har., in relation to tea in Malaya.
Publ. Dep. Agric. S.S. and F.M.S. sci. ser., 17, 1936, pp. 12, bibl. 6.

Descriptions and illustrations are given of the castes of *Microtermes pallidus*. From investigations on measures to prevent attacks the following conclusions are drawn:—1. The application of poisons such as paris green to or around the bushes had only a temporary deterrent effect. 2. Collar-pruning attacked bushes proved too drastic, some weaker bushes succumbing to the treatment. 3. The more vigorous a bush the less likely is it to be attacked, and, if an attacked bush is restored to a healthy and vigorous condition by manuring and careful pruning, the termites will abandon it. 4. All woody prunings and dead wood from the tea bushes or shade trees should be removed and burned as an additional precaution. A description is also given of *Termes javanicus* Holmg. This termite does not itself attack tea bushes, but *M. pallidus* has been found to live in association with it.

906. FERWERDA, F. P. 633.73: 581.162.3
Die Befruchtungsverhältnisse bei den in Niederländisch-Indien angebauten Kaffeearten. (Pollination in coffee species grown in the Dutch East Indies.)
Züchter, 1936, 8: 92-102, bibl. 21.

The author notes that the frequent failure experienced with vegetatively raised *robusta* coffee in the past was almost entirely due to the absence of foreign pollen in areas planted with this often monoclonal material. On taking over the selection experiments at Bangelan in 1929 he found that the yield of clonal trees in the experiments compared with that of seedling trees of same age and treatment as 63 with 100. Cramer had already found that the reason of the clonal failure did not lie in the use of unsuitable rootstocks, and the author came to the conclusion that *robusta* coffee shows the same pollination characteristics as are found in self-sterile fruit trees. This opinion was backed by the facts that large monoclonal *robusta* plantings nearly always crop badly, that the crops in such plantings decrease gradually from the margin inwards and that previous workers, e.g. Faber, van Hall and others, had found by experiment that self-pollinated *robusta* and *liberica* trees bore very poor crops. He therefore started pollination experiments, the technique of which is described here, with *C. robusta*, *C. liberica* and *C. excelsa*. He summarizes 5 years' work as follows:—This work affords a proof that *C. robusta* is entirely self-sterile and only shows a good fruit set when cross pollinated. Inter-sterility is infrequent and where found is generally not reciprocal. The same self-sterility was found in *C. liberica* and *C. excelsa*.

Certain inter-species hybrids of commercial importance were examined. The *liberica* × *arabica* hybrids proved self-fertile and fruitful when planted together. Two *excelsa* × *robusta* hybrids set little fruit when selfed and were incapable of pollinating one another. Crossed with the *liberica* × *robusta* hybrids they were completely fertile. The third group of crosses, the so-called Conuga varieties, behave like *robusta*: only the self-sterility is not quite so marked in the Conugas and pseudo-fertility is encountered among them in different degrees up to complete self-fertility. Up to date two inter-sterile groups have been established in the Conugas, the inter-sterility being reciprocal. The occurrence of abnormal seeds was carefully observed. A high percentage of blind seeds was found in the largely self-sterile sorts following self-pollination and in the sterile hybrid combinations. Probably this is a case of physiologically induced self- and inter-sterility shown in the seeds formed. At the same time factorially based zygote sterility may be concerned. The self-fertile *liberica* × *arabica* hybrids show in all self- and cross-pollinations an almost constant though high percentage of blind seeds. This might be a case of cytologically induced zygote sterility.

907. SRINIVASAN, K. H. 633.73-1.531
Preservation of coffee baskets in the nursery.
J. Mysore agric. exp. Un., 1936, 16: 17-22.

In Mysore small cylindrical bamboo or reed baskets are used for growing coffee seedlings prior to transplanting to the field. The baskets, however, are relatively expensive and decay easily, resulting in loss of the plant. After some experimental work it was found that boiling the baskets for 5 minutes in a 2% solution of copper sulphate would preserve them for six months. A higher concentration might be necessary where plants are to remain for a longer period or where the rainfall is exceptionally heavy.

908. WAKEFIELD, A. J. 633.73
Native production of coffee on Kilimanjaro.
Emp. J. exp. Agric., 1936, 4: 97-106.

The rise of native coffee growing in Tanganyika from its beginning to its present efficient stage is traced. Native methods of cultivation and the influence of European practice are described. There is some account of the workings of the Native Co-operative Union of which every native coffee grower is a member through one or other of 27 affiliated coffee societies. With a European in control the Union takes an active part in the promotion of better agricultural methods, in collecting the crop and, at present, in its marketing. Mention is made of native interest in the recently opened coffee research station.

909. VOELCKER, O. J. 633.74-1.521
Initial cacao selection in Nigeria.
Bull. agric. Dep. Nigeria, 11, 1936, pp. 45-54, bibl. 8.

Nigerian cacao with its typical yellow Amelonado pod is characteristically uniform. Selection work was started in Moor Plantation, Ibadan, in 1931 on two plots, one carrying a yellow and the other a red pod variety. Individual tree yields had been kept since 1921. Initial selection was based on yield of pods; trees averaging 70 pods or more over 10 seasons or 90 pods or more over the latter 5 seasons were marked for further consideration. This left 49 yellow pod trees, but only 3 red pod trees, and selection was subsequently confined to yellow pod trees, although it is hoped that red pod colour will ultimately be correlated with high quality, light coloured beans. On a basis of data collected during the 1931-32 season previous yields were then converted from "number of pods" to "weight of wet beans". 19 trees were finally selected for use as parents, 3 giving the highest yields, 7 on general appearance and 9 possessing relatively large beans. Further selection will be based on the self-fertilized progeny of these trees. During the same period an investigation was carried out on individual trees found to produce light coloured beans with a view to selection for quality. Some 50 self-pollinations were made, but not a single pod was set. Further attempts to obtain self- or cross-pollinated progeny are, however, to be made.

910. VOELCKER, O. J. 633.74 : 581.162.3
A study of controlled pollination in cacao.
Bull. agric. Dep. Nigeria, 11, 1936, pp. 39-44, bibl. 4.

Controlled pollinations were carried out daily when buds were available over a period of 1 year in a block of yellow Forastero, Amelonado cacao, 19 years of age. The operation was done early in the morning except during periods of cold weather. The pollinations yielded 86.0% fertilized fruits and 26.4% mature pods. Pollinations made between 21 April and 13 July yielded the highest proportion of mature pods, whereas no mature pods were obtained from pollinations made between 11 August and 30 November, a season at which very few flowers were available. At all seasons of the year shedding was heavy for about 8 days after pollination, and flowers falling within 4 days were regarded as unfertilized. During the period 26 January to 18 May shedding was continuous amongst pods of less than 50 days old; fruits that reached that age eventually matured. By contrast, during the period 19 May to 7 September there was an interval of 19 to 20 days from the 8th to 16th day onwards, which was characterized by no shedding, followed by renewed shedding to about the 80th day. Weather had no apparent effect upon fertilization, and it is, therefore, concluded that there is a wide range of dates upon which pollinations can be made with the prospect of obtaining mature fruit. In tests with 101 buds, enclosed in boxes but not pollinated, 44 were shed on the second day after opening, 52 on the third and the remaining 5 on the next two days. This confirms the idea that flowers not fertilized on the first day will fall very readily.

911. POUND, F. J., AND DE VERTEUIL, J. 633.74-1.8
Results of manurial experiments of cacao at Marper.
Trop. Agriculture, Trin., 1936, 13 : 233-41.

The results are given of fertilizer trials carried out since May 1930 on an established cacao estate purchased by the Department of Agriculture, Trinidad, for studying control of witchbroom disease. The object was to discover whether the health of the trees could be improved by the addition of suitable fertilizers so that the trees would become more resistant or, failing that, whether the increased crop following fertilizer treatment would be enough to pay for the control of the disease. Potash in the form of 300 lb. of potassium sulphate per acre showed a net profit of \$3.38 per acre per annum. Lime at 5 tons per acre gave an increased yield of 40% but cost more than the increased revenue. The increased yield from phosphate at 325 lb. per acre was worth \$1 per acre. Nitrogen gave no beneficial effect at all and decreased the good effects of other fertilizers. Potash and phosphate in combination were less beneficial than had been anticipated from their effects when used separately. This may be due to a lack of balance between the actual quantities of potash and phosphate applied.

912. WEST, J. 633.74-2.4
Black pod of cacao. Experimental control on native farms.
Bull. agric. Dep. Nigeria, 11, 1936, pp. 55-65, bibl. 3.

The results of 3 years' experiments on the control of black pod on native farms are here reported. Three applications a year of bordeaux mixture spray and of the proprietary dusts "Cupryl" copper and "Olite" sulphur reduced the amount of diseased cacao, but the reduction was uneconomic when the cost of treatment was considered. The removal at frequent intervals of all black pods and the burial of these and all pod husks did not result in any reduction in disease incidence, but it is pointed out that the treated and control plots in question were in any case much freer from the disease than the spray and dust plots. Regular harvesting at fairly frequent intervals was found to be a promising method of reducing loss from the disease. This is explained by the fact that the percentage of infected beans, normally considered lower than the percentage of infected pods, tends to be increased by delays in harvesting and decreased by frequent picking. Although the plantations used in the trials were 10 to 20 years old, regularly pruning and thinning the trees to give better spacing has been found to result in yield increases. Native farmers are, therefore, recommended to plant cacao at wider spacing and to prune the trees and harvest regularly.

913. GRAHAM, J. A. 633.825
Methods of ginger cultivation in Jamaica.
J. Jamaica agric. Soc., 1936, 40 : 231-2.

The clay lands are forked and left to dry three months before planting and a month before planting again forked and drained by means of trenches. The plants consist of pieces of the rhizome from the old crop then being dug. These are supposed to produce "bolder" and therefore higher priced ginger if left to cure for a month before planting and for this reason June rather than April or May is claimed to be the best planting time. The bits are placed 9 inches apart in furrows 9 inches deep. 1,500 planting bits are used per acre at a cost of 8/- per 100 lb. Smaller bits may be used in fertile soil. Whether planted early or late the crop will be ripe during February or March of the following year and is ready for lifting when the foliage has dried up. Ginger should be grown in full sun, shade-grown ginger having a tendency to shrink when cured.

914. MACLACHLAN, J. D. 633.831-2.452
The pimento rust disease.
J. Jamaica agric. Soc., 1936, 40 : 277-81.

The causal organism of rust disease of *Pimento officinalis* in Jamaica is *Puccinia Psidii* Wint. and during the last two years its ravages have become formidable. It attacks also *Pimento acris*, Bay Rum, but to a mild degree so far. It is favoured by cool damp weather and in such conditions is capable of spreading rapidly, the optimum temperature for infection being 55°-70°F. Higher temperatures inhibit infection. Although indistinguishable from the strain of rust attacking *Eugenia* varieties, which has been known in Jamaica for many years, cross infections have not succeeded. It is suggested that the pimento strain arose from the *Puccinia* parasitic on *Eugenia*. Severe infections kill the young leaves and flowers and sometimes twigs, causing the tree to send forth fresh shoots which are again infected. The seriousness of an outbreak may be judged from the fact that above 2,000 ft. in Jamaica practically the entire crop was destroyed last year. At lower levels outbreaks occurred but did not persist. Such control methods as eliminating diseased trees or branches, or spraying are impracticable under the conditions. Immune trees have been observed growing in the midst of diseased ones and these might prove a source from which an immune variety might eventually be raised. The author regrets that he had only 6 months to study the disease before returning to U.S.A. (Harvard University), but he is convinced that the outbreak has now reached its widest distribution. It cannot proceed effectively below 1,000 ft. and more than half the crop of the 4 years preceding the outbreak came from below this altitude. At the higher altitudes the rust is starving itself out, in that there are no more trees left to conquer. The only hope is that a spell of long continued dry weather may kill out the rust at the higher altitudes.

915. STRAITS SETTLEMENTS AND FEDERATED MALAY STATES. 633.832
Cloves (*Eugenia aromatica*).
Agric. Leaflet. Dep. Agric. S.S. & F.M.S., 12, 1936, pp. 5.

Although most of the world's cloves come from Zanzibar, Penang cloves, of which there are 350 acres under cultivation, always command a premium, being large, plump and of a bright reddish colour. Soil preferences are for well drained, friable, clay loams with good fertility in the top 18 inches, the clove being shallow rooting, and, incidentally, very susceptible to drought, especially when young. Experiments at Serdang have shown that the most successful way of raising seedlings is to sow the whole fruits closely in boxes of prepared soil under shade, transplanting when large enough and before the tap root has become elongated and twisted, to bamboo joints. They remain under gradually reduced shade till 9 months old by which time they should be 6 inches high with 10 pairs of leaves. Planting out is done at the beginning of the rainy season, planting distance being 20 ft. \times 20 ft., 124 trees per acre, on hill land in Malaya. In Zanzibar closer planting and subsequent thinning to 48 trees per acre is suggested. The

plants must be liberally supplied with rich soil in the planting holes or many will die. Overhead shade draws the tree and prevents the formation of the desired bushy crown, but ground shade is necessary to prevent erosion, and to provide this shrubby leguminous plants, e.g. *Tephrosia candida*, are suggested. They must be kept pruned, and must not be allowed close to the tree in competition with its shallow roots. The tree responds to manurial treatment though data are scarce. The Chinese in Penang, however, get heavy crops (up to 15 lb. of dried cloves per tree) with prawn refuse (analysing 3.5 to 4.5% nitrogen, 5.5 to 11.5% phosphoric acid), applied annually at the rate of 25 lb. per tree. The remainder of the bulletin is concerned with the preparation of the crop and the local marketing prospects.

916. KREIER, G. K. 633.88

The problem of natural quinine in U.S.S.R. [Russian, English summary.]

Soviet Subtropics, No. 3 of 1936 (19), pp. 60-6.

A method of producing quinine in S. Russia is described. The tree itself does not long survive the climate, but it has been found that quinine alkaloids can be obtained from quite young plants. It is proposed, therefore, to grow the plant as an annual or biennial crop. Seedlings are being tested for various desirable qualities and those selected will be vegetatively propagated.

917. HAINES, W. B., AND GUEST, E. 633.912-1.8

Recent experiments on manuring *Hevea* and their bearing on estate practice.

Emp. J. exp. Agric., 1936, 4 : 300-24, bibl. 15.

The replanting of high yielding clones is generally much more promising than manuring old stands of trees, but restriction of planting regulations and the large capital cost still make rejuvenating treatments worth consideration. Experiments conducted recently by the authors and others in various countries, some being still in progress, are discussed, and the following are some of the generalized conclusions drawn. In young rubber which retains some vigour and is perhaps planted on a poor soil an immediate increase of yield may be obtained by the use of a complete fertilizer as a first dressing followed thereafter by dressings of nitrogen only. In older rubber, which has deteriorated, further decline can certainly be prevented and probably a degree of rejuvenation obtained by the use of sulphate of ammonia. There is a prompt preliminary increase of about 10% due to improving foliage, and a much larger yield beginning in the 4th-5th year as the benefit to the bark becomes effective. These measures are usually economic, if the annual yield levels have fallen below 400 lb. per acre. Yields already relatively high are not profitably increased. Nitrogen is shown to be the fundamental need and the frequency of its application must depend on the condition of the trees. This can be judged by a standard girth increment of $\frac{1}{8}$ inch a year. Above this rate annual manuring will be unprofitable, though applications at longer intervals will maintain the trees in health and ensure a stable yield. Below this rate the need is immediate and annual applications will produce a quick response. The old rule of using sulphate of ammonia alone on rubber plantations is very sound, though in exceptional cases and especially in young or prematurely old trees other minerals or even organic fertilizers may be added as a first stage.

918. GRANT, J. W., AND WILLIAMS, A. N. P. 634.1/8

Burma fruits and their cultivation.

Bull. Dep. Agric. Burma, 30, 1936, pp. 103 + v, bibl. 27.

Chapter 1 contains general instructions for cultivation of fruits grown in Burma. Chapter 2 describes various forms of propagation. Chapter 3 gives botanical descriptions, methods of cultivation including propagation and the uses of 104 different varieties of fruit grown in Burma. Propagation of tree fruits seems to be usually by seed in Burma, but in a number of instances the authors call attention to the possibilities of vegetative reproduction. Chapter 4 is concerned with marketing.

919. STANER, P. 634.1/7

Plantes congolaises á fruits comestibles. (**Edible fruits of the Congo.**)

Publ. Inst. nat. Étude agron. Congo belge, ser. sci., 4, 1935, pp. 56.

An account is given of a number of trees bearing edible fruit and indigenous to the Congo. The author says that most of the fruit at present grown is not native to the country, though some has become practically naturalized. The indigenous fruits, however, are worth attention and are capable of improvement by selection and other means. A table of vernacular names occupying 6½ pages concludes the bulletin.

920. BELGIQUE, MINISTÈRE DES COLONIES. 634.1/7

La culture des arbres fruitiers au Kenya. (**Fruit tree cultivation in Kenya.**)

Tract Direction gen. Agric. Elev. (ser. A), 5, undated, pp. 20.

A short account is given of the fruit industry of Kenya, with special reference to methods and varieties capable of adaptation to the higher altitudes of the Belgian Congo.

921. TANAKA, T., AND OTHERS. 634.1/8

Deciduous fruit trials in the subtropics. [Japanese, 5-line English summary.]

Orchard Rec. Taihoku Imp. Univ. Fm., No. 1, 1936, pp. 17, reprint from

Shu Tai Yuan Ni (Tropical horticulture), 5:3:154-70.

A short report is given of deciduous fruit trees tested at the Horticultural Institute in the University Orchard since 1929. Pears, peaches, plums, kaki, chestnuts, figs, grapes are dealt with, and a new peach, Tokonatsu, is described.

922. BIJHOUWER, A. P. C., AND DONATH, W. F. 634.441:581.192

Over de chemische samenstelling en de voedingswaarde van rijpe mangga-

vruchten. (**Chemical composition and nutritive value of ripe mango fruits.**)

[Dutch, English summary.]

Landbouw., 1936, 11:370-97, bibl. 41.

The ripe fruits of 6 principal mango varieties of Java were analysed and compared with foreign mangoes weighing at least 350 grams and containing 70% pulp. An analysis of the skin is also given for the first time in mango literature. Total sugar of the pulp ranges from 13.1 to 16.8%, the sucrose from 9.7 to 12.8%, while the fat content of the pulp is slight. Thus in these respects Java mangoes equal the best foreign ones. In sweetness they do not exceed foreign mangoes with the exception of the manalagi, which is the sweetest mango of which analyses have been published. In calories the Java mangoes also hold their own (153 calories for a mango weighing 350 grms. and containing 75% of pulp). The literature on vitamins in mango is reviewed. Java mangoes have vitamins A and C in considerable quantity, B₁ and B₂ in small quantities and are apparently without D.

923. STAHEL, G. 634.57

De sawarie-noot, *Caryocar nuciferum* L., en enkele andere in Suriname in het wild groeiende noten. (**Sawarie and other nuts that grow wild in Surinam.**)

Reprinted from *Ind. Mercuur*, 6 Nov. 1936. *Ser. Overdruk Landbouw-proefstation, Suriname*, No. 7, pp. 18.

The butternut (*Caryocar nuciferum* L.) is indigenous to the Guianas, attaining its best development in Surinam. It is a high-forest tree and is found in stands which may amount to several hundred trees. Under suitable conditions it will reach a height of over 140 feet. Flowering starts in February and by June the fruit is ripe and has begun to drop. A botanical description

of all parts of the tree is given. Experimental work indicates that the cultural requirements of the tree are a deep light sandy loam, manuring at an early stage to help the initial growth, which is often poor and uncertain, the provision of windbreaks and of light shade till the 10th year (whether longer is not known). Propagation is by seed. Planting distance is nominally 40 ft., but, in view of the fact that some trees may have reached 30 ft. while others of equal age are still only 3 or 4 ft. high, a closer preliminary planting is advisable. Experiments in packing and transport have shown that, if the nuts are dried slowly in the shade, the kernel shrinks, causing it to rattle when shaken. Unsound kernels do not rattle and can thus be detected without opening the shell. The nuts can be cleaned by washing or brushing. Trials with consignments of shelled kernels are now in progress. One advantage of this method is that it saves 80% of the cost of freight.

924. BEIRNAERT, A. 634.6 : 581.145.1
Introduction à la biologie florale du palmier à huile. (**Introduction to the biology of the flower of *Elaeis guineensis* Jacquin.**)
Publ. Inst. nat. Étude agron. Congo belge, ser. sci., 5, 1935, pp. 42, 12 fr.

The author describes in detail, and with illustrations both photographic and diagrammatic, the flower biology of the oil palm and the distribution of the male and female reproductive apparatus in the flowers, which may be male, female or hermaphrodite. He details the exact features which may be seen in all cases and considers the factors, including hormones, which probably determine the sexual composition of individual flowers.

925. GHESQUIÈRE, J. 634.6-2.19
Rapport préliminaire sur l'état sanitaire de quelques palmeraies de la province de Coquilhatville. (**Hygiene in some palm groves of the Belgian Congo.**)
Publ. Inst. nat. Étude agron. Congo belge, ser. sci., 3, 1935, pp. 40, 4 fr.

The greater part of this bulletin is devoted to a study of various forms of chlorosis which occur in the groves examined, the last seven pages only containing notes on living parasites, entomological and mycological. Five distinct types of chlorosis are noted, the soil conditions are examined and suggestions are made for their control. The author summarizes as follows:—All the soils examined present a more or less lateritic appearance. They are characterized:—(1) by their infertility, (2) by their localized deficiency in magnesium and phosphates and perhaps also in nitrogen, boron, manganese and sulphur, all deficiencies which determine their noticeable absence of reaction to parasitic organisms, (3) by pronounced—only rarely slight—acidity which checks deep root development, (4) by the presence of an undulating layer of colloidal clay, which is frequently impermeable, and which intensifies the unfavourable effects of the first 3 features. The above give rise to the appearance of various chlorotic symptoms. It is suggested that drainage, the addition of magnesium lime and basic phosphates, and the use of sulphur and of catalytic fertilizers and stimulants should do much to remedy these conditions.

926. CRAWFORD, C. L. 634.62 : 575.18 : 581.162.3
Growth rate of Deglet Noor dates in metaxenia.
Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 51-4, bibl. 4.

A study was made of the growth rate of fruit and seed of the Deglet Noor date, *Phoenix dactylifera* fertilized by two other pollens of the same species, Mosque and Fard No. 4, and by pollen of *P. reclinata* No. 1. Periodic measurements, made during the growing season up to the time of maximum size and, later, of maturity, indicate that the metaxenial influence of pollens is effective early in the development of both fruit and seed. Although differences in fruit size were very slight at the beginning, the fruit from *P. reclinata* No. 1 pollen was smaller throughout the entire period of observation, the difference increasing until the fruit from the Mosque and Fard No. 4 pollens reached maximum size. Dates from Mosque and Fard No. 4 pollens showed no appreciable difference in size during the first month, but subsequently an obvious difference in favour of Mosque developed. Fruits from both these pollens reached maximum size at about the same

time, but the dates from Mosque pollen matured later in every case. The fruit from *P. reclinata* No. 1 pollen reached maximum size 2-3 weeks later than that from the other pollens and was likewise always the last to mature. Seed growth followed the same general trend as that of the fruit, except that maximum size was attained earlier.

927. NIXON, R. W. 575.18 : 634.62 : 581.162.3

Metaxenia and interspecific pollinations in *Phoenix*.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 21-6, bibl. 6.

Metaxenia and intervarietal pollinations in *Phoenix dactylifera* were discussed in an earlier paper*, and the information contained therein is here supplemented by a report on the influence of pollens from 5 other species of *Phoenix*, principally on the Deglet Noor date. The pollens of *P. Roebelinii*, *P. canariensis*, *P. rupicola* and *P. reclinata* have all induced late to very late ripening of Deglet Noor fruits. The last three have also produced smaller seed and fruit size than has the pollen of any *P. dactylifera* variety. Size of both fruit and seed from *P. Roebelinii* pollen has been within the range of that produced by *P. dactylifera* pollens, but the seeds have shown a distinct tendency towards abnormality. *P. sylvestris* is the only one of the five species tested on Deglet Noor, which has produced effects, all of which lie well within the range of those produced by various *P. dactylifera* pollens. Tests with a few other date varieties are mentioned to show that the pollen of these five species may not necessarily have the same effect on other dates as on Deglet Noor. *P. reclinata* is the only one of these species which produces offshoots, and the author considers that, if fruit size in Deglet Noor can be increased by thinning without eliminating the late ripening induced by interspecific pollination, this species may have possibilities for use in commercial date growing.

928. WILBAUX, R. 634.6-1.56

Les causes de l'acidification de l'huile de palme. (**Causes of acidification of palm oil.**)

Bull. agric. Congo belge, 1936, 27 : 236-54.

The existence of a lipase in the pericarp of the fruit of *Elaeis guineensis* is confirmed. Its action can be considerably reinforced by that of certain organisms, e.g. *Mucor* sp., *Aspergillus glaucus* and a hyphomycete of the *Oospora* type occurring chiefly on wounds and at the point of insertion of the drupe. The action of the lipase is closely dependent on the cytoplasmic content and the Ca ions; the H ions are depressant. Lipolytic action diminishes with the increase of free fatty acids in the medium: there is an exponential relation between the two variables: lipolysis theoretically stops when the acidity reaches 45%. The alteration of the oleine is more rapid than that of the solid glycerides. The apparent rancidification of the fresh oil is not due to an oxidase in the pulp nor to an enzyme secreted by micro-organisms. Carotin can act as an oxidation catalyst but the increase of aldehyde content of the oil in the course of industrial extraction is small, in spite of the oil being frequently aerated. The pre-existence of aldehydes or ketones in the pulp is not impossible. There is little increase of rancidity during the preservation of a clean oil. Clean well refined industrial oil alters less rapidly if kept in iron containers than in glass. Increase of acidity has been about 0.5% in 55 days. Super-centrifugal refining gives the cleanest oil and reduces danger of mould. The oil is not affected by the absorption of radiation by the black sides of the storage tanks. In practice the fruit should be brought as quickly as possible to the temperature 55°C., at which lipase is destroyed, so as to avoid any increase of activity while the pulp is being heated. The problem could be solved by the sterilization of the entire bunch as is done in Java, but under transport conditions in the Belgian Congo this would increase the cost by 50-60%. To avoid infection as far as possible bunches should be spread out on hurdles and not piled in heaps. The sites where the nuts are stripped from the bunches should be cemented and disinfected regularly, and the wooden cudgels used for detaching the nuts from the bunches should not be rough but of smooth squared wood.

* *H.A.*, 1935, 5 : 3 : 489.

929. WARDLAW, H. H., AND MASON, F. R. 634.61-1.67
An account of irrigation and drainage control for an area of dwarf coconuts.
Malay. agric. J., 1936, 24 : 421-31, bibl. 2.

The evolution of a policy is described whereby a coconut estate on fairly stiff, alluvial clay loam surrounded on three sides by salt water and with only 3 feet of drainage has been kept in good health and high yield. The steps taken were to bank out all the salt water, to separate transport and drainage canals, to maintain the transport canals full of fresh water and the drainage canals with as little water as possible by means of water gates connected with the drainage system, and to obviate stagnant water conditions by keeping the water in transport or irrigation canals at a definite level but always moving by means of weirs and water gates connected with the irrigation system. An experimental intensifying of irrigation was tried on one field of dwarf coconuts planted in 1920-21. This was done by a system of alternate drainage and irrigation channels, which provided for a slow but steady movement of soil water through the clay. The smaller channels are 3 ft. deep \times 3 ft. across or 4 ft. \times 4 ft., and the proper distance apart, depending on soil type, must be found by experiment. Difficulties due to local conditions had to be overcome and are described, as are methods of construction of drains. The question of cover crops is discussed with special reference to *Centrosema pubescens* which opens up the soil very considerably, possibly too much. The yields on the intensively irrigated fields have since been phenomenally high and the nuts very much larger.

930. CROUCHER, H. H. 631.8 : 634.61
Coconut husk ash as a fertilizer.
J. Jamaica agric. Soc., 1936, 40 : 453-4.

The value of coconut husk ash as a potash fertilizer is shown in tables of analysis. The husks should be burnt while fresh without long exposure to leaching by rain. Exposed husks gave 6 lb. per 1,000 husks less potash. The combustion should be slow and the temperature as low as possible. Rapid burning at high temperatures causes loss of potash. The manurial value of the husks varies with the soil on which the supplying palm is grown. The ash being highly alkaline should not be mixed with any ammoniacal fertilizer. Coconut ash has a high sodium chloride content and should, therefore, be used only sparingly on banana and citrus.

931. MITCHELL, P., AND MILES, E. L. 634.771-1.548
Bagging of banana bunches on the plantation.
Qd. agric. J., 1936, 46 : 264-5.

Proper bagging consists in enveloping the growing banana bunch entirely in a bag and not in merely wrapping a bag partly round the bunch. The former process gives much improved results over the latter. In this article it is shown that complete bagging results in larger fruit more uniform in size and colour, greater protection during transport to the packing shed, prevention to a great extent of loss from sunburn, splitting, exposure, pests and diseases. Bagged plants, attacked and almost defoliated by leaf spot, have carried 95% of unblemished marketable fruit, whereas comparable, unbagged plants similarly attacked showed a loss of from 75 to 100%. Disadvantages are the initial cost of bags which is £10 per acre, though most bags will last for 2 bunches, and the time taken in opening the bags when cutting the bunches. With practice, however, the maturity of the bunch can be accurately estimated by feeling through the bag. [The material of which the bags are made is not stated, nor is the stage of development indicated which the bunch should attain before the bags are put on.—ED.]

932. WOOD, R. C. 634.771-1.8
A manurial experiment on bananas.
Emp. J. exp. Agric., 1936, 4 : 365-7, bibl. 1.

In manurial experiments on Dwarf Cavendish bananas started in 1932 at the Imperial College of Tropical Agriculture, Trinidad, on a sandy loam notably deficient in potash and slightly so in

available phosphate, the use of potash gave a very profitable increase in yield. Phosphoric acid did not increase the yield. Owing to the poor condition of the stools at the start of the experiment a basic dressing of pen manure, 20 tons per acre, was given.

933. RODRIGUEZ, G. 633.771-1.875

The chemical composition of banana trash.

Trop. Agriculture, Trin., 1936, 13 : 227-8, bibl. 5.

An investigation of the chemical composition of banana trash collected from the waste packing material of bananas at the wharves in Trinidad showed an unexpectedly low content of potash. It is considered that the cost of collection and incineration of this material would exceed on a unit for unit basis the cost of imported potassic manures. The collection of green residual stalks from the retail markets overseas might be economic, since about half the fruit stalk ash is composed of potash.

934. SIMMONDS, H. W. 632.77

Fruit fly investigations 1935.

Bull. Dep. Agric. Fiji, 19, 1936, pp. 18, bibl. 12.

A detailed description with diagrams is given of *Chaetodacus passiflorae* Frogg., which attacks a wide range of fruits in Fiji, and the influence of natural enemies is discussed. An introduced Eulopid parasite, *Tetrastichus giffardianus* Silv., gives promise of better control than do local parasites and predators. Among artificial control measures that have been tested a bait consisting of 1 tablespoonful ammonia, 1 teaspoonful vanilla and 1½ pints water has proved an attractive lure, especially to females. Granadillas can be protected by enclosing the fruits, when about half-grown, in paper or calico bags. The latter can be used many times, but should be boiled after use to prevent the spread of fungus diseases. Citrus fruits for export have to be stored for 7 days and then repacked, when infected fruits can generally be easily recognized and rejected. A brief account is also given of a less important fruit fly, *Chaetodacus xanthodes* Brown. It was found to be equally attracted by the ammonia bait and under laboratory conditions has been freely attacked by the introduced parasite.

STORAGE.*

935. KIDD, F., AND WEST, C. 664.85.035.1

Recent advances in the work on refrigerated gas-storage of fruit.

J. Pomol., 1936, 14 : 299-316.

This review summarizes the results of investigational work done on gas storage of fruit by the Food Investigation Board of the Department of Scientific and Industrial Research, London. The principle of the method is based on the fact that in an atmosphere containing more carbon dioxide and considerably less oxygen than air the life of apples is found to be greatly prolonged. To ensure this condition gas-tight chambers are essential. The size of the chamber is determined by the speed at which the grower can fill a particular store with fruit. A chamber holding 40-50 tons has proved commercially satisfactory in this country. As regards construction, lining the walls with tinned or galvanized sheet steel over a concrete floor, together with vaseline coating where necessary, ensures a fair measure of gas-tightness. Notes are given on the best position of stores, of doors and of the best methods of ventilation and control of gas content and temperature. The relative humidity appears to vary between 85 and 98% of saturation in commercial gas stores and further control has not, so far, been found necessary. Instruments needed are thermometers and gas indicators. The authors consider that for certain apple varieties gas storage has the following advantages over cold storage in air :—(1) The ripening at any given temperature is slowed down to about half the rate in air and the life of the fruit is therefore doubled. (2) Low temperature breakdown is avoided by the use of temperatures

* See also 745, 747.

which do not induce it. (3) Fruit firmness is preserved almost unchanged over long periods. (4) The change in ground colour from green to yellow is markedly retarded. (5) Surface eating *Tortrix* larvae are killed in gas storage. The theoretical aspects of refrigerated gas storage are discussed and the following points are considered in detail :—Normal behaviour of apples after gathering and the effect thereon of temperature, carbon dioxide, oxygen, and volatile substances other than carbon dioxide. Finally the possibilities afforded by the method for the longer and more efficient preservation of other fruits are considered, pears in particular offering scope for such treatment. The comparative effects of varying temperature and gas content and other factors on stored apples are set out graphically in 9 figures. The authors are to be congratulated on setting out so clearly in simple language the advances made and the present position and their article can be recommended without hesitation to growers and others interested.*

936. ALLEN, F. W., AND PENTZER, W. T. 664.85 : 551.57

Studies on the effect of humidity in the cold storage of fruits.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 215-23.

Grapes :—Emperor grapes held at 32°F. in wire baskets to permit air circulation showed no moisture loss in 15 days when the relative humidity (r.h.) of the atmosphere was 100%. Respiration losses were negligible at this temperature. Transpiration increased with each decrease in r.h. down to 40%, below which no significant increases occurred. Severe shrivelling occurred with weight losses of 5 to 6%, but losses of 1.2% which resulted from 42 days' storage at 80 to 85% r.h. did not produce shrivelling. Much mould growth developed on stems and berries at 90 and 95% r.h., and in these preliminary tests the most satisfactory balance between water loss and mould growth was obtained at 80 to 85% r.h. *Apples, pears, apricots, plums, peaches* :—All these fruits when held at approximately 32°F. appeared in general to be best in appearance and texture when the r.h. was maintained at 90% or over. As with grapes a saturated atmosphere was necessary to prevent moisture loss. Data concerning water losses from 3 varieties of pears at different humidities are presented. High humidities appeared to have no detrimental effects on apples and pears, and it is thought probable that 95% would be a desirable r.h. Apricots held for 10 days at 50°F. under humidities of 95 to 100% tended, however, to develop a watery appearance before becoming fully ripe. Losses of water from all fruits held in various types of cellophane wrappers were materially higher than those sustained where the humidity was controlled by sulphuric acid solutions.

937. MILLER, E. V., AND DOWD, O. J. 664.84.035.1 + 664.85.035.1

Effects of carbon dioxide on the carbohydrates and acidity of fruits and vegetables in storage.

J. agric. Res., 1936, 53 : 1-17, bibl. 25.

In an earlier paper† the effect of CO₂ storage on carbohydrate transformation was discussed. In the present paper supplementary data on the following points are presented :—(1) carbohydrate formation in vegetables following removal from CO₂ storage ; (2) CO₂ storage of several products not previously included, namely green lima beans, plums, tomatoes and carrots ; and (3) the effect of CO₂ storage on the acidity of certain fruits and vegetables. Among fruits 50% CO₂ treatment had no effect on the acidity of Early Richmond cherries held for 24 hours at temperatures ranging from 0° to 20°C., nor 40% CO₂ on the acidity of Elberta peaches held for 48 hours at similar temperatures. Burbank plums treated with 50% CO₂ for 6 days, however, showed reductions in total acidity at 0°, 10° and 20°C., but no consistent changes in pH. Similar treatment of Earliana and Marglobe tomatoes for 6 days also resulted in a reduction of total acidity at 20°C. and in a reduction in hydrogen-ion concentration at both 10° and 20°C. Storage in 40% CO₂ retarded loss of sucrose in lima beans and carrots, the effect being greater at 15° and 25° than at 5°C. The carotene content of carrots was not reduced by treatment with 45% CO₂ up to 15 days at various temperatures. *No significant quantities of glycosides were found in either carrots or peaches after CO₂ treatment, and there were no significant differences in the

* Separates obtainable from D.S.I.R., 16 Old Queen St., London, S.W.1.

† Miller, E. V. and Brooks, C. *Ibidem*, 1932, 45 : 449-59, *H.A.*, 1933, 3 : 1 : 123.

benzoic acid content of treated and untreated Burbank plums. Carbohydrate transformation in peas was not permanently affected by CO_2 , except that for several days after exposure the treated lots still contained much more sugar than the controls. Experiments with Marglobe tomatoes stored in pony refrigerators indicated that although too high a CO_2 concentration may retard pigment formation during subsequent ripening, the acidity changes are similar to those occurring in untreated lots and the reduction in acidity accompanying ripening is not inhibited by the CO_2 treatment. The results of experiments with sweet corn are also given.

938. GUSTAFSON, F. G. 664.84.65.035.1
Influence of oxygen and carbon dioxide concentrations on the respiration of tomato fruits.

Amer. J. Bot., 1936, **23** : 441-5, bibl. 9.

When tomatoes are exposed to a condition in which the O_2 tension decreases and the CO_2 tension increases, there is a concentration at which the respiration activities are decreased, and the amount of decrease of respiration is associated with the stage of development of the fruits. The O_2 and CO_2 tensions at which this decrease occurs also vary with the stage of development. Short periods of exposure to low O_2 and high CO_2 tensions seem to be without injury to the fruits, but do retard ripening. The O_2 consumption decreases earlier—i.e. at a higher O_2 tension—than the CO_2 production. Although normally the O_2 consumption is somewhat greater than the CO_2 production, yet there is an O_2 and CO_2 tension at which less O_2 is consumed than CO_2 produced. This may be assumed to be due to anaerobic respiration. [Author's summary.]

939. BARKER, J. 664.84
The storage of vegetables.

Rep. Food Invest. Bd. Lond. for 1935, 1936, pp. 143-5, bibl. 3.

New Potatoes. *Cold store*. Results show that a higher temperature than 41°F . is necessary to avoid the risk of sweetening. *Gas store*. The beneficial effect of gas storage in prolonging the period in which the skins remain "loose" is found to be largely counterbalanced by sweetening and loss of normal texture. The best conditions appear to be 5-10% of CO_2 with from 15 to 10% O_2 at 45°F ., but further experiments are necessary to show whether even these conditions are better than storage in air. Carrots. Carrots were stored at -1°C ., $+1^\circ\text{C}$., 3°C . and 5°C . Results at -1°C . and $+5^\circ\text{C}$. were definitely unsatisfactory. At 1°C . and 3°C . sprouting was inhibited but mould developed on the unwashed samples. Samples cooked after 5 months had a moderately good flavour and texture. Asparagus. Tests indicated that 0°C . to $+1^\circ\text{C}$. is the most suitable storage temperature and that 3 weeks is probably nearly the limit of successful storage.

940. KIDD, F., AND WEST, C. 664.85.035.1
Gas storage of apples.

Rep. Food Invest. Bd. Lond. for 1933, 1934, pp. 193-9, and *Ibidem for 1934*, 1935, pp. 103-9.

As the result of the experimental work described in these two papers the authors summarize conditions recommended for gas storage of the following English apples :—(1) culinary varieties—Annie Elizabeth, Bramley's Seedling, King Edward VII, Lane's Prince Albert, Lord Derby, Monarch, Newton Wonder, Stirling Castle, the optimum conditions varying according to variety from 34°F . to 40°F ., from 0% CO_2 to 10% CO_2 and from 2.5% O to 21% O_2 (air). (2) dessert varieties—Blenheim Orange, Cox's Orange Pippin, Ellison's Orange, King Pippin, Laxton's Superb, Worcester Pearmain, again with optimum conditions differing for each fruit.

941. KIDD, F., AND WEST, C. 664.85.11.035.1
Gas storage of fruit. IV. Cox's Orange Pippin apples.

J. Pomol., 1936, **14** : 276-94.

Within the limits of the conditions tested in these experiments the maximum storage life of Cox's Orange Pippin apples was obtained at 39°F . in an atmosphere containing 2.5% of oxygen

and 5% of carbon dioxide.* Fruit stored under these conditions will develop its full characteristic flavour after a short conditioning period in air at ordinary temperatures. These atmospheric conditions cannot be obtained by the simple method of restricted and controlled ventilation, which is applicable only when the concentrations of oxygen and carbon dioxide desired add up to 21%, the concentration of the former in ordinary air. Some means of absorbing the excess carbon dioxide in the storage atmosphere is, therefore, necessary. [Authors' summary.] Effects of different conditions of storage on quality of fruit after storage for periods up to 6 months are tabulated.

942. KIDD, F., AND WEST, C.

664.85.11.037

Temperature and duration of life in apples.

Rep. Food Invest. Bd. Lond. for 1935, 1936, pp. 97-101, bibl. 6.

In the 1934-5 season Lane's Prince Albert, Cox's Orange Pippin, Allington Pippin and Blenheim Orange apples were submitted to storage at the following temperatures: -1°C . (30.2°F .), 1°C ., 3°C ., 5°C ., 7.5°C ., 12°C . and 18°C . (64.4°F .), the fruit except that of Lane's Prince Albert being gathered and stored in the post-climacteric† stage, a fact which resulted in much more serious breakdown and less tolerance to low temperature in the three varieties. Results are tabulated and discussed. The authors note as a general comment on them that, in the case of apples, when life is terminated by fungal attack, the mean duration of life of populations is affected by temperature to broadly the same extent as are the rates of such chemical changes in the fruits as those responsible for production of CO_2 , hydrolysis of starch and cane sugar, and disappearance of acid. This does not mean that fungal attack and death of individuals takes place as soon as the change in chemical composition of the tissues reaches a definite stage.

943. BECKER, J.

634.11 : 577.16

Vizsgálatok néhány magyar alma belértékéről. (Nutritional value and vitamin C content of Hungarian apples.) [English summary.]

M. Kir. Kertészeti Tanintézet Közleményei (Bull. roy. Hungarian hort. Coll.), 1936, 2 : 31-6.

Dry matter, invert sugar and total organic acid determinations and biological estimations of vitamin C were made on several varieties of Hungarian apples. The great differences found between the varieties both in nutritive constituents as well as vitamin C content is shown in tables and chart. It is stated that apples grown in Hungary appear to contain considerably more vitamin C than apples similarly tested in other countries. This superiority is considered to be largely inherent in the variety, though soil and climate may also play a part.

944. ZILVA, S. S., AND OTHERS.

577.16 : 634.11

Metabolism of ascorbic acid in the apple fruit.

Rep. Food Invest. Bd. Lond. for 1935, 1936, pp. 110-1, bibl. 2.

Results of experiments during the last 3 years seem to suggest that in young apples a great part, if not all, the vitamin C is present in the reversibly oxidized form, namely dehydro-ascorbic acid.

945. OLLIVER, MAMIE

577.16 : 634/5

The ascorbic acid content of fruits and vegetables with special reference to the effect of cooking and canning.

Reprinted from *J. Soc. chem. Ind. Lond.*, 1936, 55 : 153T-163T.

Values for ascorbic acid content of a number of fruits and vegetables determined by titration against 2:6 dichlorophenol-indophenol in acid solution show good agreement with known biological values. There was great variation in the amount of vitamin C present in different parts of individual fruits and vegetables. Decrease in vitamin C appeared in vegetables stored at room temperature and at 32°F ., but in fruits the destruction is offset by increase due to

* Author's italics.

† The climacteric is a critical change at maturity when respiratory activity quite suddenly rises sharply.—ED.

ripening. In oranges the vitamin C content appears to be governed by the percentage of juice in the fruit irrespective of variety and storage. Only small percentages of ascorbic acid are destroyed in cooking and canning, but a considerable quantity enters into the water in which the vegetables are cooked and is lost when the water is discarded. There is only an unimportant loss of ascorbic acid in stored canned material. Vegetables after storage may contain appreciably less vitamin C than the fresh material after canning.

946. KOCHS, —, AND HENKEL, H.

664.85.75.035.1 + 664.85.11.035.1 + 664.85.22.035.1

Ergebnisse von Kühlversuchen an Erdbeer-, Pflaumen- u. Apfelsorten.

(Results of cold storage experiments with strawberries, plums and apples.)

Obst.- u. Gemüseb., 1936, 82 : 24-5.

Cold storage was tested against ordinary cellar storage, and the effect of introducing ozone into the atmosphere, concentration not stated, was tried. *Apples*. The effects of cold storage at 6°C., humidity 72%, and of storage at 4.5°C., humidity 92% (when ozone was introduced) were tested against those of cellar storage at about 10-12°C. and humidity 70%. Storage life was prolonged by the use of cold for as long as 1-3 months in all the varieties tested, the ozone being beneficial in 6 cases out of 7. *Plums*. Storage life was extended by 3-4 weeks by the use of a temperature of 5°C. and a humidity of 72%. Ozone was harmful in its effects. *Strawberries*. Temperatures used were 4-7°C. with humidity of 71% without ozone and 4.3°C. and 83% with ozone. The ozone did harm in most, though not all, cases and cannot be recommended. Storage life under the above conditions varied from 1 to 2 weeks only.

947. MILLER, E. V.

634.11 : 581.192

Distribution of acetaldehyde and alcohol in the apple fruit.

J. agric. Res., 1936, 53 : 49-55, bibl. 10.

The studies reported here were conducted on the same lot of Jonathan apples as were used by Harding to determine the distribution of soluble solids and catalase activity (abstract 948). In addition Grimes Golden apples were also analysed. The peel in the fruit of both varieties was found to possess a higher acetaldehyde content than the pulp or core. The peel of soft-scalded Jonathan apples and of Grimes Golden apples showing soggy breakdown possessed a higher acetaldehyde content than did the peel of normal apples. The peel of Jonathan apples also possessed a higher alcohol content than the pulp or core, and the peel of soft-scalded fruits a higher content than the peel of normal fruits. Finely ground pulp of normal Grimes Golden apples yielded more acetaldehyde than coarsely sliced pulp, but not so much as the peel. Samples of peel, pulp and cores prepared for analysis, but held for 4 hours in stoppered flasks in a refrigerator, accumulated 2 to 4 times the original amount of acetaldehyde. On the other hand, frozen Golden Grimes apples, sampled 4 hours after freezing, showed no more acetaldehyde than normal apples, but when these apples were kept for 24 hours in the laboratory following freezing the acetaldehyde content rose to more than three times that of normal apples. These results indicate that a high acetaldehyde content of apple peel may be due partly to its production by cells ruptured in the paring process, but that there is also a tendency for acetaldehyde to accumulate in peel affected either by mechanical injury to the cells or by abnormal physiological conditions of the fruit.

948. HARDING, P. L.

634.11 : 581.192

Distribution of total soluble solids and catalase in different parts of Jonathan apples.

J. agric. Res., 1936, 53 : 43-8, bibl. 13.

Specific differences in total soluble solids and catalase activity were found in different parts of Jonathan apples. Soluble solids were consistently lower in apples affected with soft scald than in those not affected, but in both cases the greatest concentration was found in the skin, with a gradual decrease toward the pith. In normal apples catalase activity was highest in the skin and least in the region immediately beneath the skin. In apples showing soft scald catalase

activity was highest in the pith region and lowest in the diseased portion comprising the skin and the brown tissue immediately beneath it. The results of this investigation suggest that preliminary work to determine localized differences in different parts of an apple should precede chemical or physiological studies in which the fruit is customarily analysed as a whole. This procedure might lead to a modification of methods of sampling and give quite different and more significant results. [Author's summary.]

949. HORNE, A. S.

634.11-2.4

The resistance of the apple to fungal invasion.

Rep. Food Invest. Bd. Lond. for 1935, 1936, pp. 151-61, bibl. 5.

Microscopical study of the resistance. Five different apples were selected and 5 consecutive sections prepared from each of 3 positions, namely near stalk, middle and eye. The data obtained are statistically analysed. *Resistance in relation to treatment of trees.* (1) *Stocks.* Results as well as those for 1932 are graphed. In general the difference in form of curves for given stocks associated with year appear to depend on differences in range of acid-content of fruit. (2) *Manures.* The results of chemical analyses of apples received in 1933 in connexion with manurial trials in commercial orchards in Northern Ireland are tabulated and discussed. (3) *Stock and manures.* Finally data gained in experimental work at East Malling involving consideration of both rootstock and manurial treatment of Bramley's Seedling trees are here presented and the varying influence of stock and manures in 1933 and 1934 is noted.

950. KIDD, F., AND WEST, C.

664.85.13.035.1

The gas storage of English-grown Conference pears.

Rep. Food Invest. Bd. Lond. for 1935, 1936, pp. 102-10, bibl. 2.

The pears were gathered exactly as those used for the cold storage experiment (abstract 951). They were stored at 1°C. (33·8°F.), 3°C. (37·5°F.) and 5°C. (41°F.) in the following atmospheres: (1) O₂ 21%, CO₂ nil, (2) O₂ 2·5%, CO₂ 5%, (3) O₂ 5%, CO₂ 5%, (4) O₂ 2·5%, CO₂ 10% and (5) O₂ 10%, CO₂ 10%. The fruit was examined and samples were taken for ripening on different dates at 7·5°C., 12°C. and 18°C. The following notes are taken from the authors' summary of practical results:—(1) The earlier gathered fruit compared with the later gathered took the same time to ripen on removal from store, showed less wastage during ripening, and was of a lower quality. (2) There was always ample time [from 2 to 3 weeks.—Ed.] for distribution after removal from gas store. (3) The best of the tested temperatures for long store was 1°C., and when this was combined with atmospheres 2 and 3 (see above) good fruit was obtained on removal from store on 4 July. Note that the limit of storage life of control pears stored in air at 1°C. was the end of January. (4) If storage beyond the end of March is not wanted, a temperature of 3°C. can be used, the best results being obtained in atmosphere 5. Incidentally this is the same atmosphere as that used commercially for Bramley's Seedling apples. (5) Gas storage at 5°C. is unsatisfactory, the results being no better than those obtained from ordinary cold store at 1°C. The authors discuss the effects of the various treatments on hardness, breakdown, brown-heart and external browning and note the significance which the results of these experiments have for fruit gas storage problems generally.

951. KIDD, F., AND WEST, C.

664.85.13.037

The cold storage of English-grown Conference and Doyenne du Comice pears.

Rep. Food Invest. Bd. Lond. for 1935, 1936, pp. 85-96, bibl. 5.

Uniform trees on a homogeneous soil were used. Pears were picked according to one size standard on 3 occasions at weekly intervals (Comice) and on 2 occasions (Conference). Twenty pears were used for each sample. The number of samples stored at the different temperatures varied from 36 at the lower to 8 at the higher (Conference) and from 16 to 8 (Comice). Fruit was stored within 24 hours of gathering at 1°C. (33·8°F.), 3°C., 5°C., 7·5°C., 12°C. and 18°C. (64·4°F.). At the three lower temperatures the fruit was stored on trays in a separate metal cabinet, ventilated from outside the building. At the three higher temperatures storage was done on trays stacked in constant temperature rooms, the air of which had a relative humidity

of approximately 90%. The stacks were covered with damp towelling. No fruit was wrapped. The temperature-life curve was found to vary but little between the two varieties and to correspond with that found in previous pear experiments. The lower the storage temperature, the longer was the life. It was found that in the low temperature region 3°C. to 7°C. the temperature coefficient of the rate of ripening is much higher than for apples. At intermediate temperatures 7°C. to 18°C. it is much lower. Thus lowering the temperature from 18°C. to 7°C. will have a much more pronounced effect in lengthening storage life in apples than in pears, but lowering from 7°C. to 3°C. will affect storage life of pears much more than that of apples. Earlier gathering did not affect the actual date on which the fruit became eating ripe. The dates at which the pears became eating ripe at any one of the test temperatures (1°C. excepted at which ripening did not take place) are tabulated, and the question of the appropriate date prior to this at which pears should be picked in view of distribution problems, including temperature, are discussed. Where cold storage is used for Christmas markets, 1°C. has a marked advantage as compared with 3°C., but, if left too long in store at this temperature, the fruit will not ripen at all on removal to higher temperatures. There is as yet no simple method of determining when this point is reached. In these experiments good results were not obtained with Comice removed after mid-January nor with Conference removed after the end of January. The experiments confirm the belief that early gathering results in poor quality fruit and also the fact that Comice pears held at 18°C. do not develop high quality.

952. BATES, G. R. 664.85.31

Storage tests with Rhodesian oranges during 1934.

Annu. Rep. Mazoe Citrus Exp. Sta. for 1934, being Publ. Brit. S. Afr. Co., 4, 1936, pp. 107-30, bibl. 15.

Preliminary storage tests with packed export boxes of Jaffa, Mediterranean Sweet and Valencia Late oranges held at temperatures of 36°F. and 40°F. are reported. Jaffa and Valencia Late produced, mainly during the first 4 weeks of storage, dark brown discolourations of the skin, here called pitting, which in extreme cases extended to the albedo. Such markings create an unfavourable impression on the market and are therefore economically important. Pitting was more severe at the lower temperature, with late-season fruit and with ethylene-treated fruit stored soon after colouring. Oranges treated with ethylene and then wilted for 7 days before storage developed little pitting. Normally wilted fruits showed less pitting, and of these the greener fruits were less affected than the more highly coloured ones. Good control was obtained with oil paper wraps containing 8% of mineral oil and complete control, coupled, however, with an unpleasant flavour, by coating the fruit with vaseline. Pitting lesions also occurred round other skin blemishes and round the pressure marks of tightly packed fruits. It is considered to be closely associated with respiratory activity, and resembles in certain respects low temperature diseases of apples. Wastage from other causes was not prominent till after 8 weeks of storage, and ethylene-treated oranges always showed more wastage than wilted fruit. The longer the storage the more quickly the fruit deteriorated on removal to normal temperatures. Dormant infection by *Colletotrichum gloeosporioides* incurred when the fruit is young is suggested to account for certain brown skin rots and possibly for stem-end browning. Boxes stored at 40°F. showed a greater loss of weight than those stored at 30°F.

953. GANE, R. 664.85.035.1 + 664.85.771.035.1

The effects of ozone on bananas.

Rep. Food Invest. Bd. Lond. for 1934, 1935, pp. 128-30,
and

The effect of ozone on fruit.

Ibidem for 1935, 1936, pp. 126-7.

In a previous article (Tainting and the volatile products of fruits, *Ibidem for 1933, pp. 122-8*) it had been shown that ozone can be used to destroy the active substance produced by ripe bananas,

which otherwise accelerates the ripening of green fruit in the same space. In testing the effect of ozone on bananas, the fruit was submitted to atmospheres containing different amounts of ozone, namely 40 parts per million, 25-30 parts, 5-7 parts and 1.5 parts per million and the amount of CO₂ given off was noted. In the first case the rate of CO₂ production was raised considerably and injury to the peel was evident after 6 days, in the second, though CO₂ production was only slightly higher than in air, peel injury was noticeable after 8 days. Ripening was definitely delayed as compared with control conditions. With 5-7 parts per million there was no significant change in the rate of respiration or of ripening. With 1.5 parts per million neither ripening nor CO₂ output was affected, but slight injury occurred after 10 days. In the second paper an account is given of tests made to determine the possible use of ozone for the removal of ethylene or to destroy odorous substances. *Pears.* Comice pears stored at 5°C. were ventilated with air containing 3 parts per million of ozone at a rate corresponding to 1 change per hour. In 17 days no obvious injury to the fruit was apparent nor any increase in the production of CO₂. Transferred to 15°C. the fruit ripened normally. *Apples.* Exposure of Tasmanian French Crabs at 5°C. in air containing 11 parts per million of ozone resulted in injury to peel after 21 days. Stored for 22 days at 5°C. in air containing 2 parts per million ozone no such effects occurred. *Oranges.* It was found that oranges could stand quite high concentrations of ozone without suffering any deterioration in flavour or colour of fruits.

954. LEVIE, E. L. 664.85.771
 Bewaarproeven met pisangs. (**Experiments on banana storage.**) [Dutch,
 English summary.]
Landbouw., 1936, 12: 133-46, bibl. 13.

Of several processes tested in Batavia in an attempt to retard the ripening of bananas in storage gas storage gave the only promising results. Ripening was retarded up to 9 days at 12-17% CO₂ in experiments ranging from 5 fruits up to 10 bunches at a temperature of 27-5°C. Bunches picked $\frac{3}{4}$ full and shipped in an airtight container holding 10 bunches with the CO₂ maintained at from 15 to 17%, the temperature rising to 32°C., were still hard, though turning at the end of 17 days. They ripened in 2 days (in the tropics) after exposure to the air, and colour and taste were both good. The experiments are continuing with larger numbers, at least 200 bunches.

955. SMOCK, R. M. 664.85.13.021 + 664.85.11.021
Certain effects of wax treatments on various varieties of apples and pears.
Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33: 284-9, bibl. 6.

The treatment of several apple and pear varieties with waxes following spray residue removal with acid was found to retard respiration materially and to increase the concentration of carbon dioxide within the fruit. When waxes were applied in sufficient quantity, ripening at a temperature of 67°F. was retarded. Pears so treated failed to develop a normal yellow colour and possessed a marked alcohol flavour, so that unless the wax could be removed before anaerobic respiration had proceeded too far the waxing of pears offers little promise commercially. In the case of yellow Newtown apples which are consumed green, however, waxing might be of considerable value. Waxed fruits of this variety stored at 67°F. were still green and in a marketable condition after 23 days, whereas untreated apples developed full yellow colouring in about 17 days and remained in a marketable condition for only 20 days.

956. TOMKINS, R. G. 664.85.038
Wraps for the prevention of rotting of fruit.
Rep. Food Invest. Bd. Lond. for 1935, 1936, pp. 129-31, bibl. 1.

Iodine is not an ideal substance with which to treat wraps, being somewhat too volatile, staining packing material yellow, and injuring some varieties of fruit. But the fact that iodized wraps do reduce fungal rotting of fruit establishes as sound in principle the use of wraps treated with volatile inhibitors. Many substances have been tried, first as to their inhibiting properties on such a fungus as *Trichoderma viridis* or *Penicillium digitatum* and then as to their effects on

different fruits. The effect on taste is best determined by wrapping grapes in them and storing at a warm temperature for a few days. Among substances treated but for various reasons rejected are :—Essential oils (all too volatile and some dangerous to fruits) ; benzoates (wrappers thus treated do not influence the extent of rotting) ; salicylates ; and a large number of named chemical compounds. The only substance other than iodine which, it is thought, might under certain circumstances be used to treat wraps is diphenyl. It is found that wraps treated with diphenyl injure bananas and apples and that they impart a faint characteristic odour to oranges, which, however, passes after exposure to air for a few days. It also gives grapes a slightly unpleasant taint. At the same time it is suggested that in the case of oranges the disadvantages might possibly be outweighed by the fact that it definitely reduces mould.

957. BROOKS, C. 632.3/4 : 664.84 + 664.85
Transit and storage disease of fruits and vegetables as affected by initial carbon dioxide treatments.

Tech. Bull. U.S. Dep. Agric., 519, 1936, pp. 24, bibl. 18.

The results of short-period high percentage carbon-dioxide treatments are reported for over 40 different fruits and vegetables. Less decay and greater firmness and freshness were shown by the following fruits held in CO₂ compared with similar samples held at the same temperature without CO₂ :—sweet cherries, plums, peaches, Bartlett pears, raspberries, dewberries, blackberries, figs, grapefruit, oranges. Two days' exposure at 40°-45°F. to 20-25% CO₂ injured eggplant, radish, romaine, peppers, Big Boston lettuce, green bananas, while Swiss chard, endive, peas and New Zealand spinach were injured at 50% CO₂ but not at 25%. Cabbage, Chinese cabbage, broccoli, cauliflower, kohlrabi, collards, spinach, turnips, beets, corn, Iceberg lettuce, ripe bananas, avocados, and papayas were not injured by either treatment. Celery was injured after 3 days at 50% CO₂ and slightly browned at 20%. Asparagus maintained its freshness after 24 hours at 25-30% CO₂ in a temperature of 60°-70°F., but severer treatments affected the flavour. Initial CO₂ treatments maintained carrots in sweet and fresh condition and checked *Sclerotinia* and *Rhizoctonia* infections (inoculated), but not *Bacillus carotovorus*.

958. TOMKINS, R. G. 632.4 : 632.952
The action of certain substances on the growth of mould fungi.
Rep. Food Invest. Bd. Lond. for 1935, 1936, pp. 131-2, bibl. 1.

The author describes the technique employed in examining the action of certain soluble, non-volatile compounds on the rate of growth of fungi and discusses the indications offered by results so far.

959. FELLERS, C. R., AND STEPAT, W. 635.656 : 577.16
Effect of shipping, freezing and canning on the ascorbic acid (vitamin C) content of peas.
Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 627-33, bibl. 8.

Determinations of ascorbic acid were made by the 2, 6-dichlorophenolindophenol titration method in market peas, cooked market peas, cooked frozen peas, re-heated canned peas, and peas defrosted for several hours. These, compared with 0.354 mg. per gram in raw, freshly picked, immature peas, gave values which showed a close relationship to those obtained by the Sherman guinea pig assay method. The shipment or storage of peas in the pod for one or more days had a marked destructive effect upon their ascorbic acid content. Cooking either fresh or frozen peas caused a loss of 6 to 12% in ascorbic acid. Canning resulted in greater losses, but re-heating canned peas in an open vessel to 180°F. caused very little further loss. Limited data indicate no marked varietal differences in ascorbic acid content. The authors conclude that "cooked, fresh and frozen peas are good sources of ascorbic acid (vitamin C)", and that "while the canning process has a more destructive effect on the ascorbic acid of peas than freezing, still enough remains in the canned product to constitute a fair source of vitamin C".

960. GAYLORD, F. C., AND MACGILLIVRAY, J. H. 664.84.64
Storage losses in canning tomatoes.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 545-7, bibl. 1.

Experiments were made to examine the effects of delays between the time of picking and the time of canning tomatoes. The storage of tomatoes containing a mixture of grades for periods up to 72 hours was found to result in a loss in weight and grade and to produce no improvement in colour. Samples stored in the sun suffered more than those stored in the shade, but it is doubtful if the difference was sufficient to justify the expense of storing tomatoes under shelters. The storage of pale, immature, No. 2 grade tomatoes, on the other hand, resulted in an increase in the proportion of No. 1 grade fruits, a relatively small loss in weight, and an improvement in colour, and their value per ton was distinctly enhanced.

961. KIMBROUGH, W. D. 664.84.492
Curing and storing sweet potatoes without artificial heat.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 456-9, bibl. 3.

Experiments over a 5-year period have shown that sweet potatoes can be successfully cured and stored in South Louisiana, and probably in the far south of the U.S. as a whole, without artificial heat.

962. CLAGUE, J. A., AND OTHERS. 635.48 : 577.16
Vitamin C content of raw, cooked, and canned rhubarb.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 624-6, bibl. 7.

Fresh rhubarb is considered to be a good source of vitamin C. As determined by the 2, 6-dichlorophenolindophenol titration method, fresh, cooked and canned rhubarb were found to contain 0.117, 0.032 and 0.016 mg. of ascorbic acid per gram respectively. The guinea pig assay method gave protective levels comparable to these figures.

963. NEFF, M. S., AND LOOMIS, W. E. 635.939.98
Storage of French marigolds.

Proc. Amer. Soc. hort. Sci. for 1935, 1936, 33 : 683-5.

French marigold flowers were stored under various conditions for periods of 16 to 23 days and were afterwards kept for examination under ordinary conditions of temperature and humidity. A storage temperature of 40°F. proved better than one of 33°F. Flowers wrapped in waxed paper, but held dry to induce low turgor pressure, kept in better commercial condition than plants standing in water or than plants held dry and wrapped in brown paper.

PACKING AND PROCESSING.*

964. WINTER, J. D., AND OTHERS. 634.1/7 : 631.564
Picking, handling, and packing fruits for market.

Spec. Bull. Minn. agric. Exp. Sta., 169, 1935, pp. 11.

This bulletin contains recommendations on the picking, handling and packing of apples, raspberries and strawberries in Minnesota, and describes suitable containers for these fruits and plums on the lines set out in abstract 965 below. In addition a brief account is given of methods of refrigeration for the small fruits, and a plan for a simple farm refrigerator for cooling berries is included.

965. WINTER, J. D., AND OTHERS. 634.1/7 : 631.564
Packing Minnesota fruits for market.

Bull. Minn. agric. Exp. Sta., 323, 1935, pp. 18, bibl. in text.

Different types of fruit package are described with particular reference to their adaptability for marketing fruit grown in Minnesota. For apples non-returnable bushel baskets of various types

* See also 928

are almost universally used. The common forms are 2- and 3-hoop round-bottomed baskets and no change is advised except that more use be made of ring packing forms with facing discs. The apples are packed in the form, which is illustrated, the basket is placed upside down over the top and then inverted, the form being finally removed, leaving an attractively-faced pack. The eastern apple crate, which costs about 5 cents more than the bushel basket with cover, is also described, and, for small quantities of fruit to be dispatched by post, cell-type cartons may be used. For plums a shallow container of about $\frac{1}{3}$ bushel capacity would seem desirable, and a carton holding four 3-quart containers is illustrated. For strawberries and raspberries the Hallock type of berry box is commonly used and no change is recommended. Tests with 5 types of paperboard boxes indicated that none possessed any advantages over wood-veneer boxes. Ventilated crates for shipping boxes of raspberries are rapidly and advantageously replacing non-ventilated crates. A crate holding one layer of 12-pint boxes has been found very satisfactory for the autumn strawberry crop. Preliminary experiments with transparent wraps indicate that, under certain conditions, these wraps can be used satisfactorily for covering strawberries and raspberries, but there is some doubt as to whether their use at present is economically practicable.

966. BARKER, J., AND FURLONG, C. R. 664.85.13 + 664.85.3

The effect of the container on the wastage of packaged fruit.

Rep. Food Invest. Bd. Lond. for 1935, 1936, pp. 147-9, bibl. 3.

Core breakdown of pears. Experimental results suggest that the influence of the box is due to the accumulation of a volatile product of the fruit. If this is a fact, it might be advisable to use boxes and packing affording more provision for ventilation than is now the case. *Rotting of oranges.* It is found that, although bruising is more extensive in the outer fruits in the box than in the inner ones, yet the latter are more susceptible to rotting. Defects of the rind are more prevalent in the outer fruits. These effects are probably due either to differences of humidity or of the concentration of a volatile. It is considered that experiments on the effect of ventilation and humidity on packed oranges would be very valuable.

967. ANON. 634.771-1.564

Cluster packing of bananas.

Agric. Gaz. N.S.W., 1936, 47 : 515.

This method of packing bananas is shortly to become obligatory. It consists in packing bananas in clusters of 3-6 fruits, the gaps being filled with singles and twos. It has been proved that packs of this nature show less stem-end rot and squirter than singles, they take less time to complete, and the fruit is handled less. In retailing the cluster forms a better selling article and there is a reduction of wastage. The Department of Agriculture, New South Wales, is issuing a booklet (The cluster packing of bananas, H. W. Eastwood) in which the new system of packing is described and illustrated in detail.

968. RINGOET, A. 633.73-1.56

Notes sur la préparation du café. (Notes on coffee curing.)

Publ. Inst. nat. Etude agron. Congo belge, ser. tech., 1, 1935, pp. 52, 5 fr.

The author describes the whole process of coffee preparation from the time that the cherries leave the coffee bush and are graded to their final packing for transport to Europe. Numerous diagrams add greatly to the value of the article. Machinery installation costs are briefly but usefully considered and finally the more frequent faults in market coffee and means of prevention are discussed.

969. McDONALD, J. A. 633.74-1.56

A new method of curing small quantities of cacao.

Trop. Agriculture, Trin., 1936, 13 : 171-4.

This article is a brief review of a paper bearing the same title which appeared in the *Fifth Annual Report on Cacao Research for 1935*, Trinidad, 1936, and was abstracted in *H.A.*, 1936, 6 : 3 : 611.

970. LAYCOCK, T. 633.74 : 663.913

Further experiments on the fermentation of cacao.

Bull. agric. Dep. Nigeria, 11, 1936, pp. 11-6, bibl. 1.

Attention is drawn to the report of Messrs. Cadbury's specialist on samples of cacao fermented in different ways as described in a previous article*. The salient point made was that the frequency of changes during fermentation had much less effect on the final product than did the state of maturity of the beans when harvested. The two best samples were from very ripe beans. A report on the same samples by two firms of brokers, however, showed striking differences of opinion as regards the best samples, but it would seem that from their point of view, and therefore from the point of view of the general market, fermentation involving only two or three changes would be satisfactory. Confirmatory evidence was obtained from samples of cacao fermented for 7 days and changed twice, three or seven times. In the scientific report important differences were observed, but commercially all samples were classed together. In both reports, however, some preference was expressed for samples receiving 2 and 3 changes. Trials were also made of native methods of fermentation in heaps and pits, samples being changed 0 to 3 times. Heaps proved clearly superior to pits, giving a higher percentage of chocolate, as opposed to purple, beans in every case. The results also indicated that two changes in heaps were adequate for the production of a superior, first grade cacao. Finally, tests with distinctly unripe beans have shown that a very fair proportion of these may develop chocolate colour on fermenting and drying.

971. COOKE, F. C. 633.6.1-1.56

Copra manufacture.

Malay. agric. J., 1936, 24 : 332-9.

Part I (*Ibidem*, pp. 167-76, *H.A.*, 6 : 2 : 413) deals with the construction of small kilns. Part II discusses inexpensive kilns of intermediate size and describes in detail with photographs and diagrams the construction of 3 types, each of which has produced unscorched, white, dry copra without preliminary sun drying in 24 hours or less.

972. NICHOLS, P. F. 664.85.22.047 : 581.192

Notes on the sucrose content and dextrose-levulose ratio of California dried prunes.

Plant Physiol., 1935, 10 : 575-8, bibl. 6.

Analyses were made of representative samples of d'Agen prunes from the 1933 and 1934 crops of the four principal prune growing districts of California. The fruit from two of these districts is generally regarded as of superior quality to that from the other districts, and was found in both years to possess a distinctly higher total sugar content. Although no close correlation was found between total sugar, expressed as invert sugar, and specific gravity, there was a tendency for high sugar content and high specific gravity to be associated. The data on sucrose and on the dextrose-levulose ratio are tabulated. Dextrose was found greatly to exceed levulose, but neither the sucrose content nor the dextrose-levulose ratio bore any apparent relation to the district of origin or the size of the prunes.

973. HULL, R. 664.85 : 632.4

Investigation of the control of spoilage of processed fruit by *Byssoschlamys fulva*.

Annu. Rep. Fruit Veg. Pres. Sta., Campden, for 1934-35, 1936, pp. 65-73, bibl. 1.

Experiments in which cans of various fruits were inoculated at three concentrations with spore suspensions of the fungus, *B. fulva*, are described. After inoculation the syrup was added and the cans processed, central temperatures being recorded in each case. Subsequently they were incubated for 3-7 days at 37°C. or stored at room temperatures for longer periods before being opened and examined for the presence of the fungus. The results showed that a temperature of

*. 9th *Annu. Bull. agric. Dep. Nigeria*, 1930.

190° to 200°F. in the centre of the can was necessary to overcome heavy artificial infections, but in most cases natural infections were destroyed when the internal temperature did not exceed 180°F. To be on the safe side, however, it is recommended that, where possible, a temperature of at least 190°F. and preferably 195°F. should be obtained in the centre of the can. Relationships between the length of time of cooking in stationary and rolling or rotary cooks and maximum central temperatures in the can are indicated for the different fruits, and it is shown that times of cooking which would destroy infection in 45° Brix syrup would not do so in 55° Brix syrup.

NOTES ON BOOKS AND REPORTS.

974. BEDEVIAN, A. K.

42 : 581.9

Illustrated polyglottic dictionary of plant names.

Publ. by author, Cairo, 1936, pp. xv + 1109, 27s.

"Polyglottic" is certainly the operative word in describing this dictionary, for in it will be found the scientific and common names of most cultivated plants and a very large number of wild ones, in Latin, English, French, German, Italian, Turkish, Armenian and Arabic, the latter being given in both Arabic and Roman characters, the Armenian in the original and the remainder in Roman characters. These equivalents are grouped under the scientific (Latin) names of the plants, the latter being arranged alphabetically, but the work is so planned that, if the common name is known in any one of the languages, the equivalents in any of the others can be found in a moment. Although to keep the size (and weight) of the book within bounds the author has given only the most commonly used names for any plant and has omitted allied species of minor importance, the number of entries is still vast. Considering the amount of work necessary to find and verify equivalents in seven languages for this enormous array of plants, to provide illustrations for most of them, to keep the records in order, compile the eight indices and prepare the manuscript for press, and that all was accomplished by the author after office hours* in two years, with the help only of his daughter, the industry involved seems little short of appalling. The dictionary should be of the greatest value not only to the students of agriculture and medicine for whom it was primarily written, but also to all engaged in scientific work involving the frequent use of plant names, and it is to be hoped that the rather high price will not curtail its distribution. It being customary for reviewers to refer, if possible, to a misprint or so, we suggest that "louse-strife" on p. 40 of the English section is rather an unkind rendering of the noble *Lythrum salicaria*'s other name.

975. GRIST, D. H.

63

An outline of Malayan agriculture.

Malayan Planting Manual Dep. Agric. S.S. & F.M.S., 2. Kuala Lumpur, 1936, pp. 378, bibls., \$3.

The present work represents an entirely rewritten edition of the previous Handbooks originally issued in 1922 and 1924 in connexion with the Malayan Borneo Exhibition and the British Empire Exhibition. The changes and developments in Malayan agriculture since that time have been far reaching and a larger and more complete summary was called for. In this undertaking the author has been assisted by the technical officers of his and other Departments, and a very comprehensive and interesting work has resulted. Agricultural conditions, including the system of land tenure and the agricultural policy and aims of the authorities are outlined, and there is a brief discussion of modern methods of cultivation including soil treatment. A chapter is devoted to each of the major crops and to many of the secondary ones and the book concludes with a chapter each on cattle, pigs, poultry and the fresh-water fish industry. Although the book is intended for Malayan conditions, a great deal of the information is applicable

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to other parts of the tropical world and the book forms a useful reference work for all engaged in tropical agriculture.

976. JACZEWSKI, A. A. 632.8
Bacterial Plant Disease. [Russian.]

State Printing Office for Collective and Co-operative Agriculture, Moscow and Leningrad, 1935, pp. viii + 712, 120 figs., bibl. 1,734.

This treatise, "a posthumous work, revised and enlarged by Prof. N. Naumov", is a comprehensive survey of the bacteria which attack plants and of the diseases they cause. It is in Russian and was compiled by the late Prof. Jaczewski, who died in February 1932. Prof. Naumov informs us in his preface that the manuscript, as left by the author, was completed in November 1931. The book comprises two sections, general and special. The former consists of eleven chapters; the first, historical, is followed by others dealing with the morphology, physiology, reproduction, life cycles and classification, symbiotic relations, mode of infection, geographical distribution and mode of dissemination of the bacteria causing diseases of plants. One chapter describes the methods of investigating these plant diseases with an account of culture media used for phytopathogenic bacteria, and another discusses methods of control. The second part deals with specific plant diseases; the host plants are taken in the order of Cryptogams, Conifers, Monocotyledons and Dicotyledons. Under the flowering plants the various families are in alphabetical order; 59 families in all are mentioned. There are useful indexes; one of these, a bibliography of over 1,750 references to literature on bacterial plant diseases, is in two parts, with 144 references to papers in Russian and Bulgarian, the rest (in Roman characters) to work carried out in other countries. H.W.

977. KEEBLE, SIR F., AND RAWES, A. N. 634.1/7
Hardy fruit growing.

Macmillan, London, 1936, pp. 334, 16s.

The avowed primary object of this book is to supply to amateur and professional gardeners the information necessary to enable them to grow fruit well. In the second place it aims at affording an introduction to the principles and practice of commercial fruit growing. It is not a textbook for the student who wants to pass examinations or for the research worker who wants amply documented evidence, since the authors have obviously spared themselves a mort of trouble by the omission of bibliographies. They do not argue the point, nor quote this or that scientist in favour of one view or the other, but on the whole they just state "facts" clearly and precisely. It is obvious that the latest results at the British research stations are known to them and that their statements on any technical point are based on these findings. Such a method of presentation makes for easy reading and the amateur who knows nothing and the professional who knows a great deal should find it eminently satisfactory. The book is divided into three sections. In the first are discussed the making and maintenance of orchards and fruit gardens, problems of fertility and sanitation in the orchard, together with the various accepted methods of top and small fruit propagation. In addition notes are given on harvesting and ventilated stores. In the second section the hardy fruits themselves are dealt with in turn, more or less under the following heads:—forms of training, rootstocks, varieties including uses, time of flowering, pollination, pruning, descriptive lists, thinning, pests and diseases and their control. Under miscellaneous fruits one is glad to find notes on the cultivation of apricots, figs, medlars, mulberries and quinces. The third section opens with an all too brief note by Major Monro of Covent Garden on what fruit the public wants, his saddest remarks referring to strawberries, whose legendary reputation for consistent delectability is being rapidly dissipated by the false allure of heavy cropping, a character which too often indicates insipidity and dryness—so that the present strawberry of commerce can no longer be held up, as its forbear was by Dr. Johnson, as the paragon of all berries known. Yet even so, the glamour remains, and though few of us would dream of going further in the matter, who does not love to see the baskets of apparently ripe fruit decorating the windows of Piccadilly merchants in deep mid-winter? Someone, presumably, can grow them at that time. The authors tell how runners can be planted in pots

in summer, brought into the warm greenhouse about Christmas time and made to produce a succession of fruits from late February up to the normal strawberry season. Varieties recommended are Royal Sovereign, The Duke, Duchess of York and Sir Joseph Paxton, the last named for the later greenhouse crop of May and early June. Some ten pages are devoted to planning the commercial plantations and valuable notes are given on packing and marketing fruit. If we still lack our English version of *Fundamentals of Fruit Production*, we have here at least a well written and up to date account of modern English methods, and for that we are grateful.

978. KERVÉGANT, D. 634.771
Le bananier et son exploitation. (The banana and the banana trade.)
 Société d'éditions géographiques, etc., 17 Rue Jacob, Paris, 1935, pp. 578,
 bibl., 100 fr.

Fawcett's "The Banana", for years the only complete account of this fruit and its cultivation, is long out of print; with the appearance of M. Kervégant's *tour de force* it also becomes out of date. For since 1913, when Fawcett's book was published, the banana has been subjected to much intensive investigation in many directions and M. Kervégant appears to have missed none of it. In this connexion though science, perhaps, should claim no country, it is gratifying to note how much this increase of knowledge is due to the untiring efforts of Empire workers, such names as Cheesman, Wardlaw, McGuire, to quote but a few, appearing with almost monotonous regularity whenever matters of research are touched upon. Wardlaw indeed has a whole page to himself in the formidable bibliography with which the book concludes. "*Le bananier et son exploitation*" is comprehensive in the fullest sense and a recapitulation of the chapter headings is unnecessary. The student can rest assured that any available information on the banana will have been included in this book. On matters prehistoric or neo-Georgian, on the ancient claim of the leaves to have provided Eve's trousseau, on the latest methods of coping with Panama disease or on import statistics of consuming countries the information is all there and, in the case of Eve, illustrated. There are other illustrations, of which two or three are obscurely familiar, the remainder, owing to the paper on which they are printed, merely obscure.

979. KOLISKO, L. 523.3 : 581.14
Moon and plant growth.
 Anthroposophical Agricultural Foundation, Old Mill House, Bray-on-Thames,
 1936, pp. 84, 5s. 4d.

The tradition of the moon's influence on the rhythm of animal and plant life is as old as man and was firmly believed in the past by the whole community, but now with the advance of science it is forgotten or disregarded by all but the credulous. Which is strange, for surely some of the productions of science are a greater strain on the credulity than the simple suggestion that the moon, whose influence is strong enough to control the ocean tides, exerts a similar influence on the water content of the plant? For this, roughly, is what it boils down to. However, the occasion for speculation is now past. Scientific experiments have been laid down to test this influence and some of the results obtained and photographically illustrated are truly remarkable. Moreover, the experiments are so simple that anyone possessing a plot of ground or even a few flower pots can reproduce them for himself. Maize, for instance, is said to require the full force of the waxing moon at sowing time for its maximum development. A series of experiments, often repeated with similar results, are here described, in which seeds sown 2 days before the full moon germinated 8-14 days earlier than seeds sown at full moon (and, therefore, almost immediately subject to the waning influences), maintained a marked superiority in growth throughout and matured heavy crops, while the crops from plants sown at full moon either failed to mature or were meagre. Again radishes sown 2 days before full moon are found to be luxuriant in foliage, mild and tender, whereas those sown 2 days before new moon are weedy, dry, tough and astringent. Experiences with a whole series of other crops are described and illustrated. In each the influence of the moon is apparently strongly marked. The author does not, advisedly, expect her statements to be accepted without question. She says in effect, "The experiments are simple and clearly explained, try them yourselves."

980. SPRECHER VON BERNEGG, A. 633.73 + 633.79
*Tropische und subtropische Weltwirtschaftspflanzen. III. Teil: Genusspflanzen. 2. Band: Kaffee und Guaraná. (Tropical and subtropical plants of commerce. Part III, Stimulants. Vol. 2, Coffee and guaraná.)**
 Ferdinald Enke, Stuttgart, 1934, pp. 264 and 265-286, bibls. 192 and 32, R.M. 21 and R.M. 23 bound.

Coffee. Coffee, like unbalanced political or religious fervour, cacao and other stimulants, has been the unwitting cause of many repressive and cruel acts by doctors, princes and governors, who have in Paris, Mecca and elsewhere banned its consumption as responsible for paralysis, impotence, sedition and general lawlessness. Yet its hold on world taste remains unabated. The author retails some of the pious legends which enshroud its origin before passing to a consideration of coffee as we know it today. He divides commercial coffee plants into 6 groups, viz. *C. arabica*, *C. excelsa*, *C. canephora* (including *C. robusta*), *C. stenophylla*, *C. liberica*, and *C. congensis*, and then proceeds to describe the growth characters which distinguish these groups and their different important members. A general description of development, pollination and ripening in the coffee plant follows. Environment, temperature and soil conditions are next considered, after which the economic factors of labour, transport and general management receive careful attention including the question of shade plants, interculture and general planting. Sowing, planting out and the general care of a coffee plantation are then dealt with and notes are made on fertilizers and manures, special attention being drawn to the valuable work in progress at the St. Eliza research station of the Agronomical Institute at Campinas in São Paulo. Various methods of pruning are detailed and compared. Some 50 pages are devoted to pests and diseases, after which harvesting and curing are considered at some length. The composition of coffee and the uses to which the product is put receive attention and the extremely numerous adulterants are listed and discussed briefly. World production, imports, exports and the agricultural importance of the crop are dealt with very fully and it is interesting to note that figures of world production from 1927-28 to 1931-32 show that Brazil produced more than 62% of the total, the remainder of South and Central America over 16%, Asia 7%, Oceania 0.2% and Africa a mere 3.4%. Finally, there is a page of very concentrated answers to questions which might well form an examination paper on the information given. *Guaraná.* *Paullinia Cupana* H.B.K. is a plant known as Guaraná, Uarana, Huarana, Narana, etc., belonging to the *Sapindaceae*. It is indigenous to the moist heat tropics of Brazil. Its products are prized for their stimulating and medicinal properties and the paste finds a ready market in Brazil, Bolivia, Peru and South America generally. Its export to Europe is small.

981. SPRECHER VON BERNEGG, A. 633.732 + 633.77
Tropische und subtropische Weltwirtschaftspflanzen. III. Teil: Genusspflanzen. 3. Band: Tee und Maté. (Tropical and subtropical plants of commerce. Part III, Stimulants. Vol. 3, Tea and maté (or Paraguay tea.))
 Ferdinald Enke in Stuttgart, 1936, pp. 297 and 298-417, bibls. 351 and 112, R.M. 31 and R.M. 33 bound.

The author adopts the same plan as in other books of this series starting with historical or legendary information as to origins and properties and ending with a large number of questions on every aspect of the two plants and their products such as might be posed by the intelligent seeker for information with the appropriate, and almost too definite, but nevertheless extremely useful answers thereto. *Tea.* The systematic position, the morphology, biology and different chief varieties are described, the latter including Assam indigenous, Lushai, Naga Hills, Manipur, Burma and Shan, Ceylon and Yün-nan. Next the climatic demands and the effects of different meteorological factors on the tea plant are discussed. Plantation sites, economic necessities in the matter of labour, selection of seed, planting and improvement of material are all considered and some 6 pages including useful illustrations are devoted to methods of vegetative propagation, mainly as practised in the Dutch East Indies. Cultural care after planting is detailed and the desirability of shade plants is stressed, considerable attention being paid to the different plants

* See also *H.A.*, 1935, 5: 1: 122.

used for this purpose, as also for green manuring, while the results of fertilizer experiments carried out in the Dutch East Indies are also detailed. Some 60 pages are devoted to pests and diseases. Next the numerous and different processes of plucking and curing are described and notes are given on tea costings. The chemical composition of the tea product prepared as above is discussed. Its uses, substitutes and common adulterants are noted. Finally figures of world production and commerce are given. China is first in production with 47.6%, British India following with 23%. Statistics of consumption figures prove that, if tea drinking is a vice, the citizens of the British Commonwealth are relatively vicious beyond all hope. *Mate. Ilex paraguariensis* St. Hil. (or Maté) is dealt with more briefly but on the same lines. In addition there is a short section devoted to the effect of the product on human physiology.

982. GREENSLADE, R. M. 632.753 : 634.11

Horticultural aspects of woolly aphis control together with a survey of the literature.

Tech. Comm. Imp. Bur. Fruit Prod., 8, 1936, pp. 88, bibls 555 and 156, 2s. 6d.

The author deals in turn with the habits of the insect, the effect of climatic conditions on its incidence, its control and its economic importance. Annotated bibliographies, the first of a general nature, containing some 555 references, and the second dealing with control by means of parasites and containing 156 references, follow. Finally in an appendix will be found a copy of the memorandum and questionnaire sent out by the Bureau in 1933 and the names of those who sent information in response to that memorandum, these forming a useful list of workers particularly interested in the pest.

983. AMANI. 633.73 + 633.526.23

Seventh Annual Report East African Agricultural Research Station 1934-5, 1935.*

H.M.S.O., Kingsway, London, W.C.2, pp. 48, 1s.

The chief interest to the horticulturist lies in the coffee investigational work and the following notes are made from the reports of the various officers concerned :--*Director*. Large nurseries of *robusta* strain have been raised in preparation for field trials at Kwamkoro. Similar preparations have been made for planting *arabica* grafted on *robusta* while nearly all the *robusta* trees at Amani have now been cut back and grafted with *arabica*. There is additional evidence supporting the connexion of the most frequent forms of overbearing and dieback. Work on coffee root systems has developed into a study of the relation between the rate of absorption of the water and its utilization by the plant. *Biochemist*. The results of 3 methods of curing, namely pulping and drying direct at 35°C., drying in the cherry at 35°C., and pulping, fermenting, washing and drying at 35°C. (the normal method) resulted in the report from London that acidity was fair to good in each case and that the body was very fair in the first and second and fair in the third sample, thus indicating that the fermented coffee was slightly inferior to the other two. It is, however, possible that fermentation may have some beneficial effect on appearance or taste of the finished product. Tests are in progress on the germinating power of the berry during the various stages of its curing. Preparatory experiments in culture solutions have been made on acidity and root growth. *Physiologist*. Root growth of *arabica* is being studied in glass-fronted boxes of special design with Amani soil adjusted to various reactions. A field technique for the determination of starch content of plant tissues has been developed. Shade experiments are in progress. *Geneticist*. Yields and peak periods are noted for *arabica*, *robusta* and *liberica* selections and for grafted trees. Attempts to root hardwood cuttings of selected *arabica* trees were unsuccessful. A number of grafted plants of these parent trees were obtained by narching on *liberica* stocks. Layering of *robusta* stocks resulted in root development from the main stem and very few roots from the base of suckers. A few such shoots were successfully transferred to the field with a hammer-shaped rooted portion of the main stem

* Received 1936.

at their bases. Attempts to root *arabica* by layering failed. Considerable work on sisal is now in progress and the Tanganyika sisal station came into being at Mlingano in the course of the year under review.

984. ANTIGUA. 633.61

Report Agricultural Department of Antigua for 1935, 1936.

Commissioner of Agriculture for the West Indies, pp. 44.

Apart from notes on routine work with citrus, mangoes and avocados, this report largely concerns experimental work on sugar cane.

985. BRITISH COLUMBIA. 63 : 338

Agricultural Statistics Report.

Dep. Agric. B.C. for 1935, 1936, pp. 45.

The report contains statistics of the agricultural industries of British Columbia and is principally concerned with fruit and other horticultural food crops.

986. BRITISH COLUMBIA. 63

Thirtieth Annual Report Department of Agriculture, B.C., for 1935, 1936, pp. 83.

In the horticultural section the year's fruit crops are discussed. Notes are given of the demonstration work being carried out in various districts. There is an entomologist's and a plant pathologist's report in which fairly full accounts of various pests and diseases are given.

987. CEYLON, COCONUT RESEARCH SCHEME. 634.61

Annual Report for 1935 (stenciled). Bandirippuwa Estate, Lunuwila, pp. 53.

Part 1 contains the general and administrative report and the accounts of the Scheme for 1935. Parts 2 and 3, from which the following notes are taken, contain the reports of the technical officers. Yield records over four years on a very uniform piece of land confirm previous reports (from Ceylon and Malayan experiments) that high yield and low yield, both in number of bunches and number of nuts, are definite unalterable characteristics of the individual palm and fluctuate only slightly from year to year. More than 12 bunches are produced in a year and there is a positive correlation between the number of nuts and the number of bunches produced by a palm. Selection of mother palms on basis of high yield of bunches and nuts appears to be sound without prejudice to the possible employment of controlled pollination later. Seed nuts planted flat gave equal germination, but a higher percentage of survival, and to seedlings a quicker growth than was the case with nuts planted upright. The physiological reason might be that in the upright position the haustorium is out of reach of the water in the nut and has to depend on the moisture in the kernel, whereas in the horizontal position the haustorium is in contact with the water, which is apparently required for the biochemical processes involved in the transformation of the insoluble oil in the kernel into soluble sugar by the action of the lipase present in the kernel. The theory that floating nuts assume the position in which they will germinate and grow best when planted was found by experiment to be fallacious and the time and money spent by many planters positioning large numbers of nuts by flotation is therefore wasted. Germination was hastened by planting mature nuts immediately they were picked and the growth of seedlings from these nuts was significantly better than from nuts kept, as is usual, in heaps for a month after picking. Under-ripe nuts should not be used for seed. Copra curing experiments have confirmed that the weight of copra can be calculated at 32% of the weight of the corresponding husked nuts. An account of an introductory study of certain imported varieties is given with notes on their adaptation to local conditions. With one exception (San Ramon) all proved inferior to local varieties both in yield and susceptibility to beetle attack, and quality of copra. Tables of yield records for 1934 and 1935 on selected high yielding palms are given for four estates together with tables of calculated theoretical yields per acre of the offspring of

the first generation. The theoretical yields are calculated on the assumption that 60% of the daughter palms breed true to mother type and 40% half true. A questionnaire on the use of cover crops and green manures was sent to planters and others and the general conclusions to be drawn from their replies are reported. The possibility of preparing compost from fallen coconut fronds was tested, using a modification of the Indore process. The main obstacles were the length of time (over 5 months) taken by the material to decompose, although the butt ends were removed and returned in the form of ash, the difficulty in keeping the pile moist owing to the tendency of the water to run off the waxy surface of the fronds, the fact that the compost served as breeding grounds for the black beetle and the prohibitive labour costs of the operations. It is considered that the present method of manuring by the use of cattle manure and vegetable debris buried in circular trenches round the trees is more suitable and economical, since no transport is necessary and there is no waste, and in practice there is thus a compost factory at the base of each tree. A progress report is given of the large scale manurial trials laid down in 1934. An experiment to determine the changes that occur during the decomposition of husks when buried in trenches in sandy and in gravelly soil is described. A very large percentage of potash was leached which may be due to an exceptionally heavy rainfall. Decomposition was greatest in the husks treated with Adco.

988. CHESHUNT. 631.544
**Twenty-first Annual Report Experimental Research Station,
 Cheshunt, for 1935, 1936, pp. 96.**

In addition to several reports summarized in separate abstracts* notes are given on the following investigational work:—Mycological investigations:—Rose diseases, viz. *Phragmidium* sp.; "damping off" of lettuce and "crown rot" of rhubarb; carnation "stem rot" diseases, 1925-35; and *Verticillium* wilt of the carnation. Virus diseases:—Two new virus diseases of the tomato; fig mosaic; a mosaic disease of watercress; an instance of recovery from spotted wilt in *Hippeastrum* plants; some effects of tobacco mosaic virus on the growth of seedling tomato plants. Insecticide and fungicide investigations:—Red spider mite, being a note on trials with derris preparations and petroleum oil emulsion sprays with particular reference to preventing oedema on tomato plants; tomato leaf mould and cucumber mildew, being a resumé of results obtained with copper oxychloride, copper salicylanilide and cuprous cyanide. Chemical investigations:—Chlorate weed-killers in relation to injury to crop plants; a note to the effect that "red" pulp of tomato fruits contains rather more potash than "blotchy" pulp; and a note on the effect of steaming on the "availability" of potash and phosphoric acid in tomato soil.

989. DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH. 664.84 + 664.85
**Report Food Investigation Board, Lond., for 1935, 1936. Section V.
 Fruit and vegetables, pp. 85-161. Section VI. Canning, pp. 163-87.
 H.M.S.O., Kingsway, London, W.C.2, 3s. 6d.**

Section V. The following articles of horticultural interest, as well as those abstracted separately,† occur:—Metabolism of nitrogen in apple fruits pp. 111-4; The aerobic and anaerobic breakdown of carbohydrates and acids by apples and oranges pp. 114-5; The function of acetaldehyde in the catabolism of carbohydrate pp. 115-6; The determination of starch in plant tissues with particular reference to the apple fruit pp. 116-8; The influence of the carbon dioxide and oxygen in the atmosphere on the sugar content and sprouting of potatoes pp. 118-23; The respiration and ripening of bananas pp. 123-6; Volatile products of fruits pp. 127-9; The action of certain substances on the growth of mould fungi pp. 131-2; The respiratory quotient of the initial metabolism of soaked seeds (peas, maize and mustard) pp. 132-5; The respiration and water content of seeds (peas and wheat) pp. 135-7; The water relations of pea seeds pp. 138-9; A method for critically estimating the production of carbon dioxide by fruit in bulk pp. 142-3;

* See Nos. 786, 787, 789, 792, 797, 819-22.

† See Nos. 669, 672, 939, 940, 942, 944, 949-51, 953, 956, 958, 966.

The conditioning of cold stored fruit prior to retail (pears and plums) ; The freezing of vegetables pp. 149-51. *Section VI.* Most of the articles here concern problems involved in the use of different metals for fruit containers. The following deal briefly with particular fruit canning problems :—Ascorbic acid in the canning of fruits p. 180 ; The storage of soft fruits for subsequent canning (raspberries and strawberries) pp. 180-2 ; The concentration of passion fruit juice by freezing p. 182 ; The effect of various methods of storage on the setting power of the pectin in fruits pp. 182-6 ; and The effect of modifying the acidity of extract of red currants on the speed of setting and the strength of the jelly pp. 186-7.

990. GEISENHEIM AM RHEIN. 634/5
Bericht der Versuchs- u. Forschungsanstalt für Wein-, Obst- u. Gartenbau zu Geisenheim am Rhein für das Rechnungsjahr 1935. (Annual report of the Geisenheim Horticultural Research Station for 1935.)
 Paul Parey, Hedemannstr. 28, Berlin s.w. 11, pp. 29.

Very brief reports are made of the activities of the following departments or sub-stations :—*Director's Laboratory.* Work on *Venturia pirina* and other *Venturia* spp., walnut grafting, blossom biology. *Plant Disease Institute.* Spray damage, pear scab, vine sprays. *Botanical Institute.* Investigations on yeast, pollination of fruit trees, light conditions affecting succulents and similar plants. *Institute for Soils and Manures.* The pH of soil and fertilizer effect in the vineyard, soil surveys of the vineyards. *Vegetable and Fruit Products Institute.* Fruit juice preservation in an atmosphere of CO₂ under pressure, sterilization of juices by radiation. *Scientific Department.* The handling of fruit juices. *Vine Research Station.* Selection and testing of rootstocks. *Silk Department.* Selection and vegetative propagation of mulberries, sowing methods, silkworm nutrition. *Science Section of the Vine Propagation Station.* The "reisig" disease, ampelography. *Institute of Biochemistry and Wine Chemistry.* Spray residues and their removal.

991. INDIA, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH. 63
Review of agricultural operations in India 1931-2 and 1932-3.
 Delhi, Manager of publications, 1936, pp. 408, rupees 5.12, or 9s. 6d.

It is stated in the preface that a similar review for 1933-34 and 1934-35 is now under preparation. The present one should prove an excellent reference book for those who want to know where in India any work is being carried out on particular agricultural problems. Most useful tabulated information is also afforded in 14 appendixes. Of these the following are worth particular mention as giving respectively :—II. List of agricultural stations in India ; III. Staffs of provincial and state departments ; VIII. Working of agricultural colleges and schools during the period ; XIII. List of agricultural publications in India during the period ; XIV. Key to diagrammatic map of agricultural stations [which most useful item brings the review to a close.—ED.].

992. INDIAN TEA ASSOCIATION. 633.72
Annual Report Toklai Experiment Station for 1935, 1936.
 Agricultural Branch pp. 82, Chemical Branch pp. 73, Mycological, Botanical and Bacteriological Branches pp. 54.

Agricultural Branch. Investigations on the following practices are recorded :—pruning, plucking, cultivation, manuring and soil problems. In addition notes are given of several individual experimental plots and estates. *Chemical Branch.* Investigations are reported on the influence of manuring, plucking and jat of bush on the value of made tea. *Mycological, Botanical and Bacteriological Branches.* Observations are recorded on the influence of conditions of growth on susceptibility to pests and diseases. Various tests of control measures for black rot and for eelworm attacks on seedlings are noted. Botanical observations are being made on the growth of the tea plant. Bacteriological investigations have covered the natural occurrence of bacteria in different parts of the plant, bacterial changes during withering and manufacture, fermentation

tests, water sterilization, etc. [May one utter a plea for the inclusion in future of some list of contents, however brief? In its absence a particular item of work can very easily be concealed even in these short reports.—ED.]

993. JOHN INNES HORTICULTURAL INSTITUTION.

634/5 : 575.1

Record of work 1910-35, pp. 58.

The report is a brief summary of the work of the John Innes Horticultural Institution during the 25 years which have passed since its foundation, under the will of the late John Innes of Merton, for the promotion of horticultural instruction, experiment and research. Such wide terms of reference necessarily involved a limitation of practice and William Bateson, its first Director, the pioneer in this country of the new science of genetics, laid down the line of work which the Institution has followed ever since. The investigations are discussed under the following headings:—(1) *Genetical work*. Fruit investigations have been chiefly devoted to showing how the common fruit species breed and to determining the genetical basis of their fertility. (2) *Cytological work* largely on fruit and flower species. (3) *Biochemical work* largely on flower colour variation. (4) *Mycological work* including studies of the apple canker fungus, the virus causing breaking in tulips, and the edible mushroom. (5) *X-ray work* on chromosomes. (6) *Special investigations* including studies of cross and self-fertilization among commercial varieties of apple, pear, plum and cherry. One study of immediate practical interest has shown that the resistance of the Northern Spy apple to woolly aphis (*Eriosoma lanigerum*) is a heritable character, with the result that by crossing various Paradise stocks with Northern Spy seedlings, resistant varieties having the capacity for rapid vegetative propagation possessed by the stock varieties have been raised and are now being tested in the Dominions and in England. In addition the report contains a list of the staff and other workers during the period, accompanied by notes of appointments subsequently filled by them. It concludes with a bibliography of all papers, books or communications on scientific subjects published by members of the staff including, in certain circumstances, those published away from the Institution by visitors on work done at the Institution and occasionally on work done away from the Institution with the aid of grants from the council.

994. KENYA.

633.73

Annual Report Kenya Department of Agriculture for 1935, 1936.

Govt. Printer, Nairobi, pp. 132, 2s. 50c.

Points of horticultural interest are as follows:—*Coffee*. Inadequate rainfall has interfered with experiments at the Scott Laboratories, Kabete, but has allowed observations to be made on drought resistance in coffee varieties. Tests of bordeaux spraying indicate the advantages of adopting spraying as a routine practice. Promising results were obtained by the use of *Lathyrus latifolius* and other named plants as cover crops and green manures. Fermentation experiments on different curing treatments have given such small divergence in results as to indicate that quality in bean can be maintained but not improved by any of the treatments tested and that cleanliness in water, tanks and machinery is of primary importance. The pruning plot showed the superiority of the multiple stem over the single stem system, trees pruned on the multiple stem system appearing more robust and bearing a slightly heavier crop of superior quality. The necessity is shown for a study of the coffee plant in each area to ensure pruning being carried out at a period which will enable the production of flowers coincident with either the long or the short rains. A new variety from Abyssinia called Amfillo is being tested. Grafting on seedling stock in the nursery has proved much easier than on mature stock in the field. Improvement in propagation methods now ensures that 70% of coffee cuttings can be rooted successfully. Investigations are in progress on the following diseases and pests of coffee:—berry disease, Elgon dieback, mealy bug (*Pseudococcus kenyae*), *Antestia lineaticollis*, white borer (*Anthores leuconotus*) and thrips (*Diarthrothrips coffeae*). With regard to the last the conclusion has now been reached that not drought but temperature is the important factor here. *Sisal* work is in

progress on the better preparation of line fibre and on the reclamation of sisal waste tow. *Pyrethrum*. This grows well in the colony at altitudes of 7,000 ft. and especially well above 9,000 ft. Work in progress includes manuring and spacing trials, selection for yield and investigations on the effect of altitude on pyrethrum content, and on drying methods. Other crops of horticultural interest the which are being tested include various types of beans and peas, potatoes, white sunflower, *Dolichos Lablab* or Njahi, and several indigenous leguminous plants suitable for green manuring.

995. MAZOE CITRUS EXPERIMENT STATION.

634.3

Annual Report for 1934.*Publ. Brit. S. Afr. Co.*, 4, 1936, pp. 133.

A progress report is given of the investigations on the cotton boll worm (*Heliothis obsoleta* Fabr.) which periodically attacks citrus. The control of citrus thrips (*Scirtothrips aurantii* Faure) was also intensively studied and laboratory evidence obtained that a single application of lime-sulphur spray, to which colloidal sulphur has been added, is more or less equivalent to that of 2 applications of ordinary lime-sulphur at 10 days interval. This corroborates field results obtained earlier. A detailed study was made of the infection of citrus fruit by the common green mould *Penicillium digitatum* Sacc. Accounts of this and of storage tests with Rhodesian oranges are separately abstracted (Nos. 856 and 952 of this issue of *H.A.*). A detailed memorandum on the subject of the inaccuracy of the Brix hygrometer method in determining the total soluble solids in maturity tests, attributed partly to lack of uniformity in size, shape and calibration of the hygrometers in general use, has been submitted to the Grading Committee of the South African Co-operative Citrus Exchange.

996. MINISTRY OF AGRICULTURE.

634.11-1.546-1.541.11/12

Intensive systems of apple production.*Bull. Minist. Agric. Lond.*, 49, 1935. H.M.S.O., Kingsway, London, W.C.2, 3rd edit., pp. 39, 1s.

The demand for information on the intensive systems of apple production still continues and has rendered necessary a 3rd edition of this bulletin. Opportunity has been taken to incorporate much new information brought to light by experimental work on intensive systems. A section on orchard heating has been added.

997. NEW ZEALAND.

63

Ninth Annual Report Department of Scientific and Industrial Research, 1935, pp. 109, 2s.

The report deals with research in a variety of directions; only items of interest to this Bureau are abstracted. A progress report is given of the fruit tree manurial experiments and associated cold storage trials. With Cox's Orange Pippin the results of the fertilizer programme are beginning to appear. Storage quality was adversely affected by dressings of 3 lb. per tree of nitrogen. Dunn's Favourite showed a small decrease in skin cracking as a result of an application of 4 lb. of nitrogen per tree. Ammonium sulphate at 4 lb. per tree produced an increase in susceptibility to storage bitter-pit, skin mottling and fungous disease but not within 2 months after storage in a heavy crop year. Jonathan gave definite crop increases as a result of 2 lb. and 4 lb. ammonium sulphate applications, the differences between the two being not well defined owing to the season's heavy crop. Colour was depreciated by the 4 lb. rate. There was practically no breakdown in storage with this heavy crop, but some Jonathan spot occurred, and this was heavier on fruit from trees receiving a high nitrogen application. Trees heavily treated with potash produced fruit which kept greener and firmer in cold storage than the no-potash controls. Delicious showed growth response to nitrogen. Storage quality was

unaffected by any treatment. Sturmer improved all round with complete fertilizer treatments and the fruit kept free from breakdown as did the untreated controls. There was more skin mottling when nitrogen was included in the treatment. Crimson Cox's Orange did not emerge satisfactorily from the variety tests. Granny Smith imported from Victoria and grafted on a local Northern Spy proved very subject to bitter pit, though in growth and appearance it did not differ from other trees of this variety growing in the district. Six hundred trees on East Malling stocks have been distributed for observation purposes to scientific institutions. Older trees on these stocks are already planted in various districts for comparison with those on Northern Spy. A trial between Northern Spy stocks raised from clones and from root-cuttings has been laid down, the scion variety being Jonathan. Selection tests of promising strains of Delicious are being carried out, using the quickly maturing East Malling No. IX as the stock. This work is regarded as particularly important in view of the probable extensive reworking of apple orchards. Cox's Orange Pippin is also being selected and 2 apricot and 3 peach varieties. District manurial trials showed, generally, improvement of apricots, peaches and apples receiving manures, particularly nitrogen. In Central Otago nitrogen delayed maturity of peach and apricot which was beneficial in prolonging the picking season and resulted in a better price for the late fruit. Nitrogen treated apricots showed a marked decrease in frost injury. Manured lemons showed high increases of yield, particularly when nitrogen was used. This ingredient also produced a definite resistance to frost injury. Investigations of the corky diseases of apples were started during 1934. The results of trial injections with 16 kinds of chemical resulted in clearing pit from the trees treated with boracic acid. [This work has been the subject of a separate paper. Atkinson, J. D. Progress report on the investigation of corky-pit in apples. *N.Z. J. Sci. Tech.*, 1935, 16: 316-9; *H.A.*, 5: 3: 384.—ED.] Soil investigation showed that corky-pit was most severe on soils having a lightly packed stratum of clay near the surface, overlying a more open subsoil. The root systems of badly affected trees showed small fibrous rooting but were otherwise normal. Leaf and fruit analysis showed that the boron content of healthy trees was 3 times that of trees bearing pitted fruit. Further trials are in progress to determine the value of boron treatments for pit in commercial orchards where recent losses from this trouble have been heavy. In storage and transport trials Cox's from clay loams wasted more than those from sandy loams. Early picked Cox's became pitted while late picked became soft to the point of collapse after 6 weeks in cold storage. In temperature trials 36°-38°F. showed the least wastage. Two years' investigations show that the causal factor of Jonathan scald is not the all-round wrap.

998. PILLNITZ AN DER ELBE. 634/5
Tätigkeitsbericht der Höheren Staatslehranstalt für Gartenbau. . . . zu
Pillnitz a. d. Elbe 1933-36. (Report of the Horticultural College and
Experiment Station of Pillnitz on Elbe 1933-36.)
 Pillnitz, 1936, pp. 81.

A general report on the teaching side of the establishment is followed by reports of particular departments. The more important would appear to be those for:—*Fruit growing nursery and rootstocks*, the chief work being on rootstock selection for Southern Germany, root growth and strawberry breeding. *Vegetables*. Work includes selection trials of tomatoes and cucumbers and breeding of asparagus. *Fruit and vegetable products*. *Landscape gardening*. *Chemistry*. Here experiments are in progress on the effect of soil acidity on lettuce and cucumbers. *Botany*. Work is in progress on methods of inducing early germination of apple, pear and quince seed (see abstract 651). *Plant protection*. At the end of each brief account of sectional activity a short list is given of the more important publications issued during the period covered by the report. [From the point of view of the foreign horticultural worker it is a great pity that the valuable work of this research station is reported in detail in so many scattered journals and not under one cover. Thus 14 articles published by members of the Fruit growing and the Botany sections are issued in no less than 12 entirely different journals!—ED.]

999. RUBBER RESEARCH INSTITUTE, MALAYA. 633.912
Annual Report Rubber Research Institute for 1935, 1936, pp. 163,
 \$1.

The report on the scientific work of the year covers the following subjects among others. Soil regeneration, cover plants, manurial trials, replanting, various investigations on budding technique and stock scion relationships, physiology in relation to latex production and many investigations into the chemical aspects of rubber preparation. A progress report of the work at the Experiment Station is included.

1000. SIERRA LEONE. 634.3 + 634.774 + 633.682
Annual Report Sierra Leone Department of Agriculture for 1935,
 1936. Govt. Printer, Freetown, pp. 46.

Appendix II contains an account of the activities of the Newton Experimental Fruit Farm. Here the citrus experiments have been reluctantly abandoned owing to soil poverty and death of trees from trunk rots. Budding in the citrus nursery has been confined to Marsh grapefruit and Lu Gim Gong orange on sour orange stocks. Experiments on dry land banana growing have shown this to be uneconomical, but experiments on swamp land banana growing have had excellent results. In the pineapple experiments information is being accumulated on the length of time necessary for suckers of different types to produce fruit. All pineapples were mulched, irrigated during the dry season and given one application of fertilizer at the rate of $\frac{1}{2}$ oz. each of the following per plant :—sulphate of ammonia, superphosphate, muriate of potash. Several thousand pineapples of the varieties Red Spanish, Queen, Smooth Cayenne and Baronne de Rothschild have been planted. Some 8 varieties of cassava have been grown and kept free from mosaic with a view to distribution.

1001. STRAITS SETTLEMENTS AND FEDERATED MALAY STATES. 63 : 31
Malayan agricultural statistics, 1935.
Econ. Ser. Dep. Agric. S.S. & F.M.S., 7, 1936, pp. (tables) 90, 50 cents.

The publication furnishes a useful summary of local information regarding agricultural conditions, in a convenient form for easy reference.

1002. STRAITS SETTLEMENTS AND FEDERATED MALAY STATES. 63
Reports of the research, economic and agricultural education branches for the year 1935.
Gen. Ser. Dep. Agric. S.S. & F.M.S., 24, 1936, pp. 89, 50 cents.

The annual reports of the Heads of the various divisions are given in full in this bulletin. In view of the great activity shown by the Department mention of any particular work in a general report is necessarily brief, but many papers on the work done and results obtained have been contributed to the *Malayan Journal of Agriculture* and abstracted in *H.A.*

1003. TANGANYIKA TERRITORY. 633.73
Second Annual Report Coffee Research Experimental Station, Lyamungu, Moshi, for 1935, 1936, pp. 19, 1s.

The report outlines the work accomplished during this year. Individual records of cherry yield have been recorded for 10,000 trees situated in all the coffee areas of Tanganyika Territory. Of these only 5 trees have failed to show pronounced biennial bearing and have yielded over 400 ounces of cherry in two successive years. Preliminary to field experiment knowledge has been obtained as to suitable plot size and natural yields for 2 seasons. Various methods of vegetative propagation have been worked on and are discussed. Softwood cuttings of two or three internodes with only the last pair of leaves removed gave very successful results in the

solar propagator. In addition, work is in progress on leaf analysis for diagnostic symptoms of nutrient deficiencies, on soils, and on pest and disease control.

1004. TANGANYIKA TERRITORY. 633.526.23

Annual Report Department of Agriculture for 1935, 1936, pp. 148, 4s.

The sisal experiment station at Mlingana started at the end of 1934 is nearing completion and the first plantings of blue sisal (*Agave amaniensis*) have been made. A manurial trial in connexion with banding disease and a spacing trial have been laid down on outside estates. [The report of the Coffee Research Station is abstracted separately, abstract no. 1003, and the other crops dealt experimentally with do not concern this Bureau.—ED.]

1005. TRINIDAD AND TOBAGO. 633.74

Administration Report of the Director of Agriculture for the year 1935, 1936, pp. 58, 42 cents.

The report gives briefly the results to date of certain experiments. *Distance spacing trials* with cacao trees planted in 1914 at 12, 14, 16 and 18 ft. apart and shaded with an immortal tree in the centre of each group of 4 shows that with increasing age the trees planted farther apart are bearing the more heavily. Experiments (started 1922) with closer spacing are in progress with at present somewhat inconclusive results partly due to soil differences, but it may be said that the yields obtained with the 6, 8 and 10 ft. spacing of tree experiments compare favourably with those obtained for trees of the same age planted at double the distance. *Propagation.* Comparing the yields of seedling, budded and grafted cacao under estate conditions, it is found that on the shaded section for 1935 the budded at stake plot has given the highest yield with the seedlings last, and that the average for 18 years places seedlings second to budded at stake though nursery budded and grafted trees are gaining ground. On the unshaded section the seedling plots continue to give the highest yields. *Colour of pods.* Budded trees of red pods continued to give much higher yields than yellow podded trees whether on the same or separate stocks. *Trenching.* Plots of 60-year-old trees 15 ft. apart under light shade were trenched 2 ft. wide and 18 inches deep in 1931 and (a) the trenches filled with any vegetable material available on the spot, (b) filled with pen manure. Both trenched plots showed greatly increased yield this year over untrenched controls, (b) being the most productive. These have already been reported in full in the Annual Reports on Cacao Research [and abstracted in the contemporary issues of *H.A.*] issued by the Imperial College of Tropical Agriculture.

1006. UGANDA. 63

Annual Report Department of Agriculture, Uganda Protectorate, for 1935, part I. Govt. Printer, Entebbe, pp. 46, 3s.

This part of the report is confined to a review of the agricultural position, field work and agricultural education and to accounts of the Department. For Part II see *H.A.*, 1936, 6 : 2 : 422.

1007. WAGENINGEN. 63 : 016

Acta agraria vadensia. I. 1934.

Publ. Landbouwhoogeschool, Wageningen, 1936, stencilled, 8vo., pp. 55.

The first issue of an annual record of scientific papers on agriculture, horticulture, and allied sciences published mainly under the auspices of the Landbouwhoogeschool, Wageningen, Holland. This deals with publications of 1934. Each title is accompanied by a full abstract in English, with the object of bringing the papers under the notice of a wider circle than heretofore. Seventy-two authors are represented, many more than once.

1008. WASHINGTON.

634.1/7

45th Annual Report State College of Washington Agricultural Experiment Station for the year ending June 30th, 1935.

Pullman, Washington, pp. 83.

Information on fruit problems is contained in parts of the reports of the Divisions of Chemistry, Entomology, Farm Management and Home Economics and Plant Pathology. It is also given by the Division of Horticulture in brief notes on pp. 44-48 under the following headings :— Orchard cover crops ; peach harvesting, packing and storage ; winter injury ; orchard fertilization [manuring.—ED.] ; effect of oil sprays on apples ; spray residue on apples and pears ; set of fruit ; orchard irrigation ; development of methods of propagating hardy apple stock ; breeding red raspberries ; strawberry breeding. Notes on vegetable work (pp. 48-49) concern potato storage and breeding and tomato breeding. Further observations are made with regard to work at the Irrigation Branch Experiment Station on soil moisture relationships in the orchard. The work of the Cranberry-Blueberry Branch Station is also briefly reported.

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